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OUR TWO BRAINS.

BY RICHARD A. PROCTOR.

(*Continued from page* 190.)

IN the remarkable case which closed the last portion of this article, one side of the brain had been so severely injured that one might fairly have expected the mental faculties would have suffered if the brain is to be regarded as a single organ. Just as the proper work of an eye cannot be done when one half of the eye is seriously injured, nor the proper work of an arm if the upper or lower arm is seriously injured, or the muscles on one side or the other of the arm be torn or lacerated, so if the two sides of the brain form but a single organ injury to one side must in the most marked degree affect the power of the brain to perform its proper work. Yet here was a case where one side of the brain was so injured that manifestly the whole of that side must have been disabled: yet the boy was able to think as well as before, to move about with his customary freedom of action, to do all in fine which he had been able to do before he received the injury.

In passing I note that there have been many remarkable cases of the same kind, proving as much as this case did, but not more. Among these cases, I may cite one not so widely known as it deserves to be,—the case of the boy McEvoy, who was killed by an accident in a saw-mill at Paterson, N.J., somewhere about the spring of the year 1876, if I remember rightly. In that case, the boy had stooped under the revolving saw, and partially rising, his head came against the saw which cut through his hat into the skull, so deeply that while one end of the opening was only a little above the right eyebrow, the other end was close to the crown of the head. In gauging the wound the doctors were able to extend an instrument more than an inch within the inner surface of the skull, near the middle of the long gash. It was expected that the boy would be dead before he reached the hospital; but not only did he survive the journey, but he was able to talk and was apparently in full possession of his faculties a few hours after the accident occurred. He lived till the fifth day, and his death then was sudden and unexpected, due apparently to inflammation caused by the presence of fragments of the torn hat within the wound. During the last two days, the doctors who before had had no hope of the boy's recovery, took a sanguine view of the case. He was certainly in full possession of his mental faculties up to within a few hours before he died. Unfortunately the boy's mother would not allow a *post-mortem* examination to be made, so that it was impossible to say how deeply the saw had really penetrated into the boy's brain.

In the next case cited by Dr. Wigan, it was found during *post-mortem* examination of a patient of his own that one hemisphere of the brain was entirely gone. Yet the patient, a man about fifty years of age, had conversed rationally and even written verses, within a few days of his death. The evidence here is more decisive than in either of the cases just considered; for in those cases one-half of the brain though seriously injured was yet not destroyed and one might imagine that some of the functions of that half might continue to be discharged, severe though the injury was. But where one hemisphere was found to have been entirely absorbed before death, it is impossible to explain the possession of reasoning powers within a few days of death, unless we suppose one-half of the brain sufficient for the full exercise of the mental faculties.

But the following case is still more remarkable:—

A gentleman came to the celebrated Dr. Conolly, under the following circumstances. He had applied a very strong embrocation to the cheek for some ailment there, and an inflammatory disease had been caused by its action. This disease spreading through the eye orbit had affected the brain, and when he applied to Dr. Conolly the case was in reality hopeless. By slow degrees the disease prevailed. A *post-mortem* examination showed that one hemisphere of the brain was "entirely destroyed—gone, annihilated—and in its place," says Dr. Conolly, "a yawning chasm." "All the man's mental faculties were apparently quite perfect." His nurse (and landlady) whom alone he permitted to attend upon him, declared that his mind was clear and undisturbed to within a few hours of his death. "He had a perfect idea of his own awful situation, and his landlady—having been gradually accustomed to the sight of horror—was alone allowed to come near him. He would not even permit his own sister or other relatives to witness his frightful condition."

Dr. James Johnson mentioned to Dr. Wigan the case of a gentleman who came under his care, "who retained the entire possession of his faculties to the last day of his existence, yet on opening his skull, it was found that one cerebrum was reduced by absorption to a thin membrane—the whole solid contents of one half of the cranium, above the tentorium, absolutely gone." This gentleman showed no sign of mental weakness, but he was subject—it will not be much wondered at—to epileptic fits.

In the next case to be considered, it was made clear on a *post-mortem* examination that the only active part of the brain had been the right cerebrum. The convolutions of the left cerebrum were in so diseased a state that when the brain was removed from its case a large quantity of serous liquid escaped from the left side, and the mass was reduced to one-third its former amount, and to about one-fourth that of the right side. In this case there had been partial paralysis of the right side, showing how the left brain governs chiefly the motor system of the right side of the body. This partial paralysis had existed from childhood; and the paralysed members were wasted and atrophied. But the intellectual faculties were entire, the patient possessed the use of his senses, and was able to walk with the help of a stick.

In Cruveilhier's "Anatomie Pathologique du Corps

Humain," from which the previous case is cited, there is a plate representing the right cerebrum entirely destroyed by apoplexy; yet the owner of this half-destroyed brain, "jouissait de toute son intelligence."

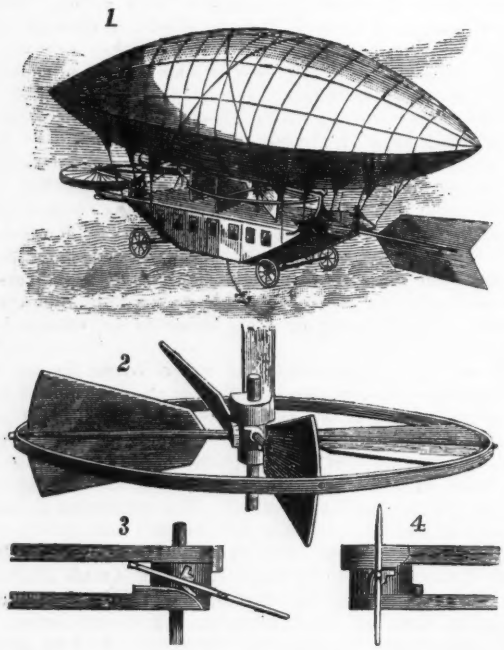
It is singular that Cruveilhier, in dealing with this and similar cases, speaks of the intelligence remaining unimpaired, with so little emphasis as to show that he had not paid special attention to the circumstance. Yet surely nothing can be more thoroughly inconsistent with the belief that the brain is to be regarded as a single organ, in this sense, at least, that the various portions of it are all essential to its complete action.

The same is the case with other writers,—as for instance with Dr. Abercrombie, who describes a case in which there was a frightful cavern in the right side of a man's brain, yet the man preserved his intelligence entire until the very moment of his death,—without dwelling in the slightest degree on the conclusion to which such a case seems inevitably to point.

(To be continued.)

AN AËRIAL PROPELLER.

THE accompanying engraving represents an aërial propeller recently patented by Mr. M. H. Depue, of Homer, Ill. The propeller, Fig. 2, has a rim and hub in



which are journaled radial blades; each journal of each blade being provided with two transverse arms in the same plane. The main rudder for guiding and controlling the machine is shown in the right side of the perspective view. Upon each side, at the other end of the balloon, is a rimular rudder used to raise and lower the machine when balanced in the air, thereby avoiding the necessity of throwing out ballast or letting out gas. The under part of the balloon, next to the car, is made straight, thereby giving the propeller more power, and the car a better shape for the other attachments. When the car descends, it alights upon small wheels, which prevent scraping and sliding on the ground. Figs. 3 and 4 show the hub of the wheel and the frame and a single paddle or blade in different positions.—*Scientific American.*

PLEASANT HOURS WITH THE MICROSCOPE.

By Henry J. Slack, F.G.S., F.R.M.S.

THOSE who live near heaths should at least examine the three most common sorts, if they are in a region that does not grow the rarer kinds. Ling, *Erica*, or *Calluna vulgaris*, is very widely spread all "over Central and Northern Europe to the Arctic Circle, and westward to the Atlantic, from Labrador down to the Azores." So says Bentham in his "Handbook of British Flora." Generally growing in this country where furze is plentiful, the two plants, with their contrast of golden yellow and purplish-pink, varying to nearly white, give a glow of beauty to the landscape. The most obvious thing to notice with Ling, or Common Heather, is the profusion of flowers on the same stem, arranged tier above tier. This is handy for the bees, and they take some time before they have exhausted the treasures of a single spike. The little flowers have both calyx and corolla deeply cleft into four lobes, which open rather widely, and, with the help of a little magnification, show the projecting pistils closely surrounded by groups of anthers, with little white tails, standing out in a more or less horizontal circle. The disposition of the flowers is also horizontal, with a tendency of the styles to turn upwards. A pocket-lens will show that the easiest way for a bee to thrust in its long tongue is below the pistil. In doing this, it touches the little anther tails, which act as levers, and spread out the anthers so that their pollen falls upon the insect.

The best way to display the ling flower under the microscope is to fix one quite upright in a bit of beeswax in the middle of a glass slide. The wax, about half the size of a peppercorn, should be softened by heat, but not melted, and the stem of the flower held in a pair of forceps and pressed into it. The object can be illuminated with a lieberkuhn—a very useful instrument, though somewhat out of fashion—or with a bull's-eye lens, or, as I prefer in such cases, by a side silver reflector, mounted on a stand with universal motions, like those given to the bull's-eye. A three-inch objective is a sufficient power, and if the observer's eyes are a *pair*, and not, as is frequently the case, two odd ones of different focal lengths, a binocular instrument is advantageous. As soon as a bee retires from one flower it goes to another and rubs upon its stigma some of the pollen it previously received. In the course of its operations it will impregnate different flowers on the same stem, and also others on different plants. There are a great number of contrivances amongst plants to secure cross-fertilisation, and when these are adapted to make insects the pollen-carriers the flowers are called *entomophilous*, distinguishing them from those fertilised by wind-borne pollen, which are named *anemophilous*.

Viewing the ling flowers with a good pocket-lens, or as just described, it is easy to see two rows, or whorls, which both look like corolla segments. The outer one is the calyx, coloured like the inner one, the corolla, and the four calyx-looking green leaflets are bracts.

If the observer, after becoming familiar with the ling flowers, examines the Scotch heather, *Erica cinerea*, also called purple heather, it will be noticed that its leaves are

larger than the former, the plant bigger, and the flowers much fewer, and at the top of the stems. Each flower, instead of opening with wide clefts in the corolla, is a close, egg-shaped bag, with a small round mouth and star-shaped lips, through which the stigma slightly protrudes, and partially closes the way. Of similar structure is the elegant pink or cross-leafed heath, which has a tuft of nodding flowers at the top of its slender stem. At first sight it does not appear why botanists call it "cross-leafed" (*Erica tetralix*), but if one of the whorls is snipped off with fine scissors and fixed upright in the wax, it will be seen that the four leaves

Fig. 1.—Erica vulgaris.

Fig. 2.—Anther of Ling (F, filament; *t*, tails).

form a cross, and that at the base of each one is a scale with a ruby glandular swelling at its base. The marginal hairs on the leaves are also worth notice. An insect like a bee could not thrust a tongue into these little bottles without rubbing against the stigma, which is viscid when the flower is ready for fertilisation, and as the invading instrument goes further, it opens the ring of

Fig. 3.—Cross-leaved heath.

anthers and receives their pollen. To watch the process, a bee should be caught in an inch-wide test-tube. This is easily done by holding the tube close to the entrance of the hive, and corking up the first bee that walks into it. A sprig of the heath should then be inserted, and, after the creature has exhausted its anger by rushing about, and buzzing in the tube, it settles on the flower, and thrusts its tongue down among the anthers. The one before me, as I write, cannot reach the bottom of the flower-cup. Removing the pink heath, I replace it with a sprig of ling, which seems to please the insect, and it forages diligently from flower to flower, easily reaching the bottom. This process is watched with a 1½-in. lens, the lowest of a set of three, as the opticians sell them in tortoiseshell mounts.

The bell of the cross-leaved heath should be opened by removing one side or the upper half, which can be done with needles. This discloses the round, green, ribbed ovary the pinkish style, and green stigma, with the group of tailed anthers below it. Fig. 1 shows the form of the ling flower with its open corolla; Fig. 2, one of its tailed anthers; Fig. 3 represents the elegant bell of the cross-leaved heath; and Fig. 4, the same, more magnified and with the upper part torn away to show the pistil, surrounded with the group of tailed stamens.

I frequently find a species of thrip in the flowers of the ling, in its larval and mature states, and I cannot discover

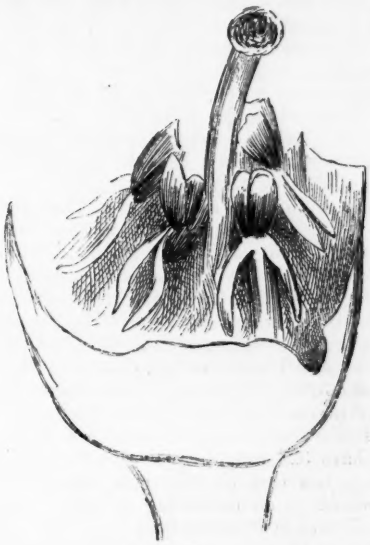


Fig. 4.

that it does the flower any harm. It can suck the nectar without piercing the corolla, and that food does not appear to yield the material that forms the pitchy excrement of the greenhouse plague, which does as much harm by depositing this stuff as by its feeding upon the chlorophyll.

STATISTICS OF BARATARIA.

By Grant Allen.

I.

BARATARIA is an island in the Utopian Ocean, containing a population of one thousand adult persons, of whom five hundred are males and five hundred females. All these five hundred couples are newly married; they have just been planted as a colony on the island; and the Director-General of Statistics is now engaged in drawing up some interesting calculations as to their probable natural increase during the next five or ten generations.

I must apologise at the outset for this very abrupt method of plunging *in medias res;* but if one wishes to expose a fallacy, there is no better way of going to work than by reducing it at once to its simplest elements. Now, there are a great many rampant fallacies about races and populations at present implicitly current in the world at large, which, perhaps, may best be met by positing the simple and easily comprehended case of the island of Barataria.

People generally get rather confused when they come to talk about twenty or thirty millions; they can hardly fail to grasp the issues really involved when it is a mere question of a poor little thousand. Let me add, also, by way of preface, that I am not going to trench upon the debateable ground of the Malthusian problem. My object is ethnical and historical alone, not political or economical.

It is obvious that if every one of these married couples were to have two children apiece, one a boy and one a girl; and if all these children were to grow up, without a single death or misadventure; and if all of them were then to marry, the population on the whole would remain exactly stationary. True, there would be just one apparent increase to double after the birth of the new pair into each household; and the normal number of the population would ever afterwards be two thousand, instead of one: but in each subsequent generation there would always be a thousand children born; and the sum of parents and children would never greatly exceed or fall short of the round two thousand. For simplicity's sake it may be added that in Barataria the children are usually born when their parents are thirty, and the parents themselves usually die in their sixtieth year.

But, as a matter of fact, an average of two children to each family will not, of course, suffice to keep the population of the island from positively dwindling. Out of every thousand children born in Barataria, as in England, 150 die during the first year, 53 during the second year, 28 during the third year, and so forth. By the time they were all 21, and therefore marriageable, only 657 out of the original thousand would be left, of whom 331 would be young men, and 326 young women. Some of the men would, of course, of necessity have to remain bachelors, so that instead of five hundred couples, as at the beginning, we should only have 326 couples to recruit the population in future. It results that at this rate the population of Barataria would go on decreasing in the proportion of nearly two-fifths at each generation; and as we must make some small allowance for couples who do not wish to marry, we may fairly say that it would become practically extinct in seven generations. Roughly speaking, the decrease in the number of married couples would be to 300 in the first generation, 180 in the second, 108 in the third, 63 in the fourth, 36 in the fifth, 21 in the sixth, and 12 in the seventh. By that time it would be impossible to carry it on much further without an importation of fresh blood from outside to renew the impoverished stock.

It is clear, then, that an average of two children in each family will be quite insufficient even to keep up the population to a fixed standard. Indeed, if we are going to allow for infant mortality, we must put the average at more than three; and if we reckon the chances of invalids, bachelors, old maids, and other casualties, we must put it as high as four. In other words, the population of Barataria will not keep stationary even, I take it, unless each married couple on the average has as many as four children. In that case, a generation will consist of 2,000 children, of whom 1,314 will reach maturity. But of these only 652 will be girls; and allowing 152 out of that number (not an excessive estimate) for weaklings, nuns, old maids, and girls who die unmarried, we get back exactly to our original 500 couples.

This looks a startling conclusion, but it is, nevertheless, a pretty certain one. If the married couples of Barataria have only two children apiece, their population will decrease with surprising rapidity. If they have four apiece, it will barely remain stationary. If they want it to increase perceptibly, they must have five apiece or more.

Observe, too, that as some families will have only one, two, or three children each, there must be some which have more than four, even to keep the inhabitants of the island up to the fixed number. Families which have less than four children from one generation to another, are families that are gradually dying out. They represent the decadent element in the total population. Families that have more than four children are families that are gradually gaining ground. They represent the progressive element in the population. After a few hundred years, the population will consist of their descendants alone, or almost alone. As a matter of fact, so high is the real average of early death, of celibacy, and of other checks, that even five children are not enough to keep a population up to its normal level, under the circumstances of western Europe.

But the average fertility of married couples in real life, either in Barataria or in England, is something greatly in excess of this modest estimate of five children apiece. And it does not remain fixed, as I have here supposed, no matter at what age the women marry: it varies greatly with the age at the date of marriage. Dr. Matthews Duncan has shown that when women marry at seventeen they have on an average nine children each (I omit decimals, which after all are far from lively to look at, and seldom affect the practical result), when they marry at twenty-two they have seven, at twenty-seven they have six, and at thirty-two they have four and a half. Even this last comparatively high average is not, in the actual state of England, sufficient to keep up the population to its normal level. Mr. Galton has very ingeniously shown, in his "Inquiries into Human Faculty," that if all the women of a race were to marry at the age of twenty-nine, there would be a steady decrease in the number of their descendants from one generation to another. Let us put his case a little more concretely than he has done by applying it to two different classes which go to make up the population of Barataria.

Half the married couples with whom we have stocked the island are Europeans, and the other half are negroes. Now, we find in this particular case that our negro mothers usually marry at twenty (on the average), and our white mothers at twenty-nine. The result will be that our negro mothers will produce about eight children apiece, and our white mothers about five. This, however, does not in itself sufficiently express the rate at which the negroes will gain upon the whites; for while the average length of time between one generation and another among the blacks will be twenty-seven years, among the whites it will be thirty-six. In other words, not only will the negresses be absolutely more fertile, but their generations will follow upon one another with far greater rapidity: so that at the end of any given time—say, a century—the blacks will have gained doubly upon the whites—first, by greater number of births to each mother; second, by greater number of generations to the given time.

Mr. Galton's figures enable us to see exactly how fast these two causes of relative increase and decrease would tell upon the total population of our island. Let us start with 100 white mothers and 100 negresses. After 108 years (the least common multiple of 27 and 36) the number of female descendants who themselves become mothers would have risen to 175 among the negresses, while it would have sunk to 61 among the whites. At the end of the next equal period, namely, in 216 years from now, the number of negro mothers would be 299, while that of white mothers would only be 38. After the third period had lapsed (in 324 years) the number of black mothers would have increased to 535, while the white mothers

would have dwindled away to 23. By that time, close intermarriage among the whites would have begun to work out their complete destruction, and in a very few years more the blacks would have completely supplanted them. Out of the two equal races with which we originally peopled the island, the one race would have quintupled itself, and the other race would have utterly died out, simply owing to the fact that the women in the one case married early, while in the other case they married late.

So far, I have taken it for granted that both the races will keep quite distinct. But in real life, it is quite impossible to put two races in close contact with one another, and yet prevent constant intermarriage or its practical equivalent. Do what you will, the two races *will* get mixed. Take an example where pride of race and prejudice are at the very worst; where one might naturally imagine that intermixture would be hardest and tardiest; where the very name of miscegenation is scouted and detested. In Jamaica, the total population in 1881 was in round numbers 560,000. Out of these, only 14,000 were white. But what effect had this small body of whites had in leavening the total population of the island? It seems incredible, but the brown people (mulattoes, quadroons, &c.) the mixed offspring of the two races, numbered over 100,000. Roughly speaking, one may say there were 450,000 blacks, 14,000 whites, and 100,000 of mixed parentage. Nothing could better show how absurdly impossible is the attempt to ensure purity of race where two distinct populations occupy the same district. And when one gets such close intermixture, the problem of separating between the two races becomes after a time absolutely insoluble.

(To be continued.)

THE WORKSHOP AT HOME.

By a Working Man.

SUPPOSE that in Fig. 12 (p. 155) the ends, *t*, *t* (*e*), instead of being of the form there shown, had been made of the shape *t* in Fig. 15, and that the opening into

Fig. 15.

which they fit, instead of having parallel sides, as seen from the top, were formed as at *s* in the figure above, we should have what is known among joiners as a rudimentary form of the "dovetail" joint, one of the commonest employed in joinery and cabinet-making. *t*, in Fig. 15, is called the "pin," and *s* the "socket." Before proceeding to a de-

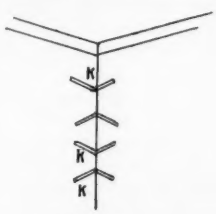


Fig. 16.

tailed description of the way of making the joint, I may advert to a kind of imitation of it, known as "mitre and key," which is used in the trays of dressing-cases and the like, and which is a good deal stronger than it looks. Fig. 16 illustrates it. It represents one side and part of the end of a small box or tray. The two pieces of board are first "mitred" (*i.e.*, planed at an angle of 45°), and joined with glue. Subsequently, two or three cuts, as shown at *k k*, are made with a saw alternately upwards and downwards, and slips of very thin wood glued and driven into them, the projecting pieces being removed when the glue is cold. I shall presently have something to say about the way of cutting mitres, as the mitre-joint is a very common one in picture-frames, &c. To return now to our dovetail, Fig. 17 representing the ordinary form of it. The dovetails,

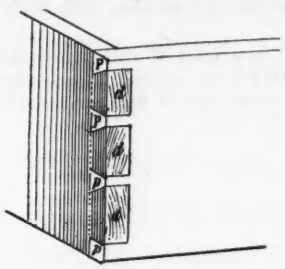
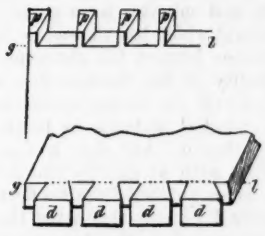


Fig. 17.

d, appear on the front of the box, drawer, or other piece of work; and the pins are cut very much smaller, in order that they may show as little as possible. They are made first. The workman as often as not marks them out with his eye, but the amateur had better do so by measurement. The wood being first properly planed up and squared, the marking-gauge (Fig. 8, p. 154) is set to the thickness of the board, and both the sides and ends of the box marked in both sides as at *m m*. The two end-pieces should be at least twice as thick as the intermediate ones. A, Fig. 18, shows how the pieces are marked; they are cut down to the gauge-line *g l*, with the tenon-saw (Fig. 2, p. 154) and the intermediate wood removed with the chisel. Note that in cutting towards the *bottom* of the intervals between the pins, the flat face of the chisel is held next the solid thickness of the board, and the tendency should be rather to leaving the outside edges on *g l* higher than the middle than otherwise. This insures a closer joint. To the same end the pencil lines marking the pins should be left visible in sawing. Having thus cut out our pins neatly, we lay the second piece of wood down on our bench or table, and setting the pin-piece upright upon it, with the pins in their intended places, and with their thicker ends on the gauge-line, or towards the inside of our box or drawer, we pass a thin, sharp bradawl along the two



Figs. 18 and 19.

sloping sides of each of them, and so mark out their shapes. Then, as before, we put the end or dovetail pieces upright, and with our tenon-saw saw along their gauge-lines, leaving them just visible. Finally, we remove the little piece of wood with the aid of a chisel, and our dovetail piece, as shown in Fig. 19, is complete. Fig. 17, above, shows how these

two pieces mutually fit together. The beginner will be careful to leave both pins and dovetails full large, in order that the joint may be a tight one; but they obviously must not be *too* large, or they will split the wood when driven home. Assuming, then, that we have got a sufficiently tight-fitting joint, the pins and hollows between the dovetails are brushed over with thin hot glue, and then the parts are replaced, a mallet being used to drive the pins home, as quickly as may be, and the whole affair put aside for twelve hours or so, until the glue has set.

When a box is being made, it is evident that there will have to be four sets of pins, with their corresponding dovetails.

The dovetail is a joint of such importance and in such common use, that I recommend the amateur mechanic to practise it on waste bits of deal for the sake of attaining proficiency in it.

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

CHAPTER IV. (*continued*).

WHEN our observer has pushed his way as far south as he can, at which time the southern pole of the heavens will be nearly overhead, he will have completed his survey of that particular section of his abode; and having satisfied himself that it is a semicircle (wanting only two short arcs at each end, which he has been prevented from traversing by the difficulty which enormous icebergs have opposed to his progress) he returns to his first station to commence explorations in new directions.

He first sets out towards the east—in other words, keeping the pole of the heavens continually on his left hand.

He finds now no change whatever in the aspect of the heavens, and if he were not very watchful he might be led to suspect that there was nothing to be gained by pursuing his researches in this direction.

But our observer *is* very watchful. He has set forth to determine the earth's figure, and he means to master the problem, if it can possibly be done.

As before, he has taken with him an accurate chronometer, one which will not only enable him to measure the rate at which the heavens rotate, when he is stationary at any place upon his route, but to compare the aspect of the heavens at any instant with the aspect which they present at the place he started from. In other words, he has a chronometer which will enable him to know exactly how many hours and minutes have passed since he left home, let the interval which has elapsed be long or short.

Now, in his former journey his chronometer, or rather this particular quality of his chronometer, did not serve him much. He found no change either in the uniform character of the celestial motions, or in their rate; and, further, he found that on any day a star reached the highest point of its path at exactly the same time as it would have done when watched from his first station.

But in this second journey this is not the case. When he is stationed at any place the heavens rotate precisely at the same rate as before; but, while he is travelling, the heavens seem to rotate faster. In other words, according to the distance he travels towards the east he finds the heavens farther advanced than he knows they appear to persons at his original station. For example, when he has travelled about 430 miles towards the east, he finds that a particular star reaches its highest point in the north about forty minutes sooner than as seen by his friends at home.

It is clear that this was to a certain extent to have been expected. As he is travelling towards the region from beyond which the stars seem to rise, he might naturally expect to see them rise sooner. But as he has already convinced himself that the stars are at a distance incomparably exceeding the distances he has travelled, he knows that by travelling in a straight line he could not produces such changes as he observes.

For example, suppose that A (Fig. 3) is his first station, W A E the east-and-west line, S A N a part of the earth's circular section in a north and south direction. If at A, a star is in the south, as at *s*, at B the star will appear towards the west of south, or advanced towards its setting, or in direction B *s*. But as *s* has been shown to be very far off indeed, the angle A *s* B would be very small, whereas it really amounts to about 40 minutes' motion; that is, to about 10 degrees.

It is clear that if his second journey is like the first, along a circular path, the observed change will be readily explicable, because his horizon would then be continually changing, and instead of having to assume a change of place in the star, he could explain its observed change of direction, as due to a change in the direction of the north-and-south line, by which he estimates the star's

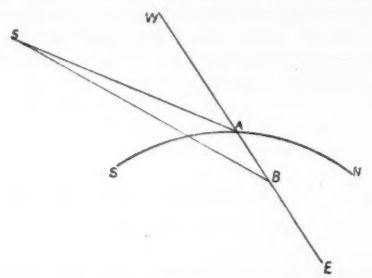


Fig. 3.

position. The change is one which it would be by no means easy to illustrate satisfactorily, because in reality the horizon plane is shifting in a rather complex manner. But the attentive reader cannot fail, I think, to understand the accompanying illustration.

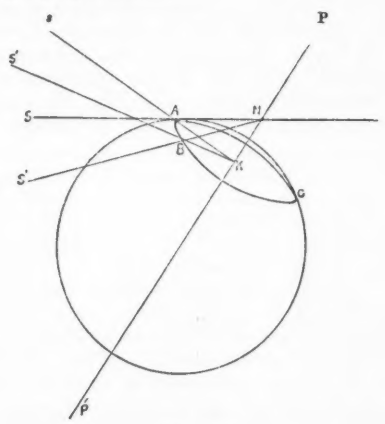


Fig. 4.

Let A, Fig. 4, be the first station of the observer, S A N the north-and-south line, P P' the direction of the earth's

polar axis, K A s at right angles to P P′, the direction in which a star that rises due east is seen when due south. Then, as the traveller sets off square to N A S, and keeps on travelling in a direction square to the line drawn (as S A N is) to the axis P P′, it is clear that he travels in a plane square to the axis P P′. Let A B be the arc he traverses round K, then N B S′ is his new north-and-south line, and K B s' the new direction of the star when due south. Thus the angle s K s' is that by which the star comes sooner to the south. A B then, the path of the traveller, measures the angle he has traversed round K. But we have seen that that angle is about 10°, where A B is about 430 miles. Hence, *if* the new path of the traveller is a circle, it has a circumference of 36 times 430 miles, or 15,480 miles—that is, a radius of about 5,000 miles.

Our traveller continues his journey, and finds that there *is* a uniform change corresponding to a uniform increase of the angle A K B, as he travels uniformly onwards, and he concludes that the path he follows is therefore a circle about K. Nay, he can continue his journey until he comes quite round to A again, and he thus finds that that circle has a circumference of about 15,500 miles, as his first observations promised.

Thus he learns that a second section of his dwelling-place is circular, and this at once suggests that he is living upon a sphere, because the sphere is the only figure whose sections are all circular.

We shall now see how he completes the demonstration as the earth's globular figure, and then, with a brief sketch of the less perfect demonstrations commonly found in treatises of astronomy, and a few comments on some phenomena which have seemed to throw doubt on the theory that the earth is globular, this chapter on determining the figure of the earth will be completed.

(*To be continued.*)

DICKENS'S STORY LEFT HALF TOLD.

A QUASI SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from page* 210.)

TO return to the events preceding the attempted murder. It has been arranged, we note thirdly, that Mr. Grewgious is to dine with Rosa on Christmas Day. As an essentially methodical man, he would probably make the journey on Christmas eve, arriving perhaps at Cloisterham late in the evening. He might even have gone to the Crozier (the orthodox hotel), afterwards visited by Mr. Datchery. Certainly Mr. Grewgious was at Cloisterham early on the 25th, but how early we are not told. Rather strange, I take it, that we see nothing of Mr. Grewgious till late on the evening of the 27th, nearly three days after the attempted murder, and that *then* he comes only to speak to Jasper in a tone which would be utterly brutal unless Mr. Grewgious were absolutely certain that Jasper was the murderous villain to whom all the trouble was due. This tone, which Mr. Grewgious maintains not only throughout the scene with Jasper but to the last, could not possibly be based on such suspicions as Rosa would have conveyed to him (in any case). From no one but from Jasper himself or from Drood, could Grewgious have derived that sure information which would alone cause a rigidly just, though angular man like him to treat Jasper as he did.

So much for some of the points preceding the attempted murder. (These and other matters are more fully dealt with in my article in *Leisure Readings*.) Let us now turn to what is related in connection with that event.

It is clear, in the first place, that Jasper is careful to drug his victim; we have seen how he drugged Durdles, carefully watching how the drug took effect, and in what way the victim passed from under its influence. It was probably after Drood's return from his walk with Neville to see the effects of the storm, that Jasper persuaded him, in what Drood called his moddley-coddleying way, to take a warm drink before going out to watch the effects of the storm from the tower.

It is clear, secondly, that Jasper's first attack on Drood was made with "the large black scarf of strong close-woven silk," which he probably pretended to round his victim's throat to keep him from the cold, but (having him once so held) drew suddenly tighter, and hauling Drood to the edge of the tower, cast him down to "that stillest part which the cathedral overshadowed," and on which he had gazed so intently when on his expedition with Durdles. But Drood struggles so that "some stones on the summit of the great tower" are "displaced" (by the storm, the people think next day); as he falls, the fierce wind mercifully drives his body against the sculptured face of the tower, to which he clutches, breaking his fall. (For though, we learn afterwards, when Jasper goes through the scene again under the influence of opium, there was "no struggle, no consciousness of peril, no entreaty," yet was there *something* which, in his many visions of the event before it happened, he had *never seen*. "I never saw *that* before," he says.) Falling to the roof, Drood clutches the lead covering, a part of which is carried away, rolling up as more and more yields with his weight. (The strength of the wind, supposing nothing were indicated by what is said about the roof, would have sufficed to carry Drood from the direct downward course to the slant roof, still further breaking his fall.) But when Jasper descends, after looking down (as he afterwards tells us) on the body of his victim, he finds Drood apparently dead, strips from the body the watch, chain, and breast-pin, which can alone, as he thinks, resist the corroding action of the quicklime, and casts it into the tomb prepared for it, locking the door of that tomb and of the crypt, and hastening to his own room.

So much we can guess, and indeed so much Dickens may be said to tell us. I take it that then (as in Dickens's striking story, "The Signalman"), the dream-voice which Durdles had heard the preceding Christmas Eve is heard in reality Durdles lying drunk in the precincts, and unnoticed by Jasper, hears, after Jasper has retreated, a terrible scream (but not, this time, "the howl of a dog"), and making use of his wonderful power of determining what lies inside stone walls, detects just what he had described during the "extraordinary expedition,"—inside Mrs. Japsea's tomb, "Something betwixt us, sure enough, some rubbish left in that same six-foot space," and opening the tomb finds that rubbish to be quicklime, into which has been hastily flung the body of Drood, his face fortunately protected by the strong silk shawl with which Jasper had intended to throttle him.

We may suppose that Durdles dragged the body out of the tomb and out of the crypt, and was there presently assaulted first and helped afterwards by the impish Deputy. They carry the body away—perhaps to the Traveller's Rest, where as Drood came to himself he would be taken, all draggled and lime-stained as he was, for one of Durdles' workmen, who "doing what was correct by the season," had fallen into a heap of quicklime and narrowly escaped death. Durdles himself, being drunk, would readily have

XUM

supposed that the lime "had been left in that six foot space by Durdles's men," and that the man he had rescued from it was one of them. Or Grewgious, disturbed from his rest at the Crozier, may have been by when the body was taken out, and have seen to its removal to the Travellers' Rest, there first finding who it was, and taking due measures to keep the matter hidden—possibly at the suggestion of Drood himself—until a scheme for the punishment of Jasper had been devised. Durdles and the Deputy would be easily bribed to secresy. Note in passing, as a rather striking piece of evidence respecting Drood's whereabouts on Christmas morning, that Datchery alone of all the characters of the story, knows the nickname by which the Deputy is called at the Traveller's Rest. "Halloa, Winks," he says; and Deputy seems surprised. "I say," he remonstrates, "don't yer go a-making my name public," explaining how the name was given to him, and what it means. It is certainly suggestive that Datchery should know of a name which the Deputy says "the travellers give me" ("give" being here in the past tense). It may be pointed out as entirely inconsistent with this that when Mr. Datchery first meets, or seems first to meet, the Deputy, Datchery asks his name, and the Deputy says "I don't owe yer nothing; I never seen yer." For clearly Drood's question is quite consistent with his having seen the Deputy before (apart from which his disguise has to be considered), and of course the Deputy would not recognise him in his entirely changed aspect.

Now let us consider what follows the disappearance of Edwin Drood.

In the first place, we find that after the impeachment (I use Dickens's own word) of Neville Landless, Jasper employs Christmas Day in preparing measures for making as widely known as possible how much he himself is troubled about Drood's death, and how grievously he suspects Neville. Doubtless the whole of that day Jasper took care to be in the sight of men as much as possible. He had not got rid of the watch and pin then, for, when found, the watch had run down, and it was wound at two on the afternoon of Christmas Eve, so that it would run till late on the evening of Christmas Day. Jasper, then, cast the watch and breast-pin into the water on the night of the 26th or 27th, for during the daytime on the 26th and 27th he was with the river-searchers. As the watch was bright enough to catch Crisparkle's eye in the running water on the morning of the 28th, I take it that it was probably flung into the weir, or rather carefully placed where it might be seen, not earlier than the night of the 27th, on which point we shall presently note further evidence. That stress was to be laid on this point is shown by the way in which attention is directed to the winding of the watch at two, and in which the jeweller's opinion is probed. He is made to say that he is positive it had never been rewound, a strange thing to say, seeing that no man, jeweller or otherwise, could be positive on such a point, though Dickens (who had some rather strange ideas as to what an expert might infer) may very well have supposed that such a matter might be determined. It is clear we are to take it as provable that the watch was put in the weir after the evening of the 25th.

It seems to me probable that immediately on learning of the attack on Drood, Mr. Grewgious sent for Buzzard, to keep watch on Jasper's movements, and that Jasper was followed when he went to the weir to place Drood's watch, chain, and breast-pin there. We shall see that there is other reason for supposing that Buzzard was early employed to keep Jasper in view.

(To be continued.)

EMIGRANTS' PROSPECTS IN AMERICA.

FROM AN ENGINEER'S POINT OF VIEW.*

By W. R. Browne, M.A.

THE first thing which strikes an engineer in approaching Canada is the overwhelming abundance and cheapness of timber. It is not merely that, as the steamer sweeps up the magnificent reaches of the St. Lawrence, the eye takes in mile after mile of virgin forest which nobody has touched or seems to think worth touching; where the only sign of man's presence, beyond fishermen's huts scattered thinly along the shore, is that here and there a few thousand acres have been devastated by bush-fires, leaving a rich carpet of scrub a perfect "fireweed," with white skeletons of dead firs standing out of it by thousands. It is still more of a shock to find in Quebec that the "side-walks" are composed of nothing but 3-in. planks, cut to length, and roughly spiked together on beams, side by side; and that the new "Dufferin Promenade," and even some of the streets, are roughly paved with the same material. Whenever there is a job to be done of any kind, it would seem that a Canadian's first idea is to cut down a tree to do it with. It does not need the large rafts of logs anchored off Point Lewis—the suburb on the opposite shore of the St. Lawrence to Quebec—to impress on the mind the immense extent of the lumber trade in Canada. Down a single river—the beautiful St. Francis, along which the Grand Trunk Railway is carried from Richmond to Sherbrooke—I was told that some forty million logs are floated every season. And the warfare goes on unremittingly, without any thought, or as yet apparently any need of thinking, whether it may at last be carried too far. True, things are not as they were in the early days, when fences were made of walnut wood, and valuable timber, in itself worth many times the fee simple of the land it stood on, was felled and left to rot, or burnt for firewood. Now every stick got within manageable distance of a railroad has a definite value, and is worth saving. But still there is no thought of replacing what has been taken away. The ground whence the trees have been removed is either brought into cultivation, or nature is left to repair her damages as best she may.

It does not take long to form a conviction that Canada, from the engineer's point of view, is a very unpromising field. Agriculture, in which the timber track may be included—since trees are, after all, only one form of produce—is the one great staff of the country, and Canadian agriculture needs very little help from the English engineer. To begin at the beginning. Take the process of reducing a tract of forest land to culture, as explained to me by a veteran in the art, and let us see how far English machinery comes, or can come, into the operation. A Canadian bush in summer is almost an inland forest carpeted with weeds and flowers and grasses, rich with abundant but not impenetrable underwood, and thickly studded with fair-sized trees, yielding more or less valuable timber. These trees have mostly English names—elm, beech, ash, poplar, cherry, &c.; but though probably cognate species, are very seldom identical. When such a bush as this is to be cleared, the first requisite is obviously to fell the trees. Here it might appear that the tree-cutting machine

* From the *Engineer*. This article, says our contemporary, possesses a melancholy interest. It was intended to be the first of a series of papers to be written by Mr. Browne, as our special correspondent with the British Association. It is the last he ever wrote, and the announcement of his death reached us by telegraph, while his manuscript was still on the Atlantic.

exhibited not long ago might find employment, but—not to speak of difficulties in getting it to work on the right spot—it is sufficient to observe that two French lumbermen, each with a good axe, will fell a spruce, 2 ft. in diameter in ten minutes. It is likely to be a long time before machinery can compete with hand labour of such quality and on such work. The trees—with the exception of saplings 6 in. in diameter and less, which are cut even with the ground—are hewn down, so as to leave stumps about 3 ft. high, which form very unsightly objects in all new clearings. The reason for this will appear shortly. The trees so felled—unless burnt as they lie, which was often the practice in early days—are hauled off the ground by gangs of lumbermen—"teamsters," earning 40 dols. a month—and taken to the saw-mill, or brought down to the nearest river, and launched in vast rafts down the stream to cities and civilisation. This takes place, of course, in the winter, and as soon as spring has fairly set in, the preliminary operations are completed by setting fire to the weeds, scrubs, saplings, &c., and reducing the whole, together with the larger stumps, to charred fragments and ashes. The ground is then immediately sown, as it best may, with wheat, and grass seed is scattered in at the same time. The wheat is cut in the "fall," generally yielding a fair crop; the stubble is crushed down by the snow in the winter, and the grass springs up in the following spring. After three or four crops of hay have been got, the ground becomes "pasture," and is browsed by cattle for a space of some five or six years more. By this time the smaller stumps are rotten, and can be drawn out of the ground by a team of horses or oxen. Between the large stumps which still remain it is possible to plough, and the ground may now be brought into ordinary cultivation, generally on the four-course system. In three or four years more the large stumps are amenable to the same treatment. They are drawn accordingly, with more or less difficulty, and the last vestige of the primeval bush has disappeared.

Now, in the whole of the above operations it is obvious there is very little which can claim the aid of the engineer. Even ordinary agricultural implements—reapers or ploughs—are hardly applicable so long as the stumps remain to cumber the ground. It is true that, as I was told, a sanguine Scotchman, some years ago, proposed to use traction engines for the purpose of drawing these stumps, without waiting for their decay. He even induced people to find money for the purpose—for what purpose will not people find money, if it be only absurd enough?—but the practical results were as might have been expected. Stumps are, as a matter of fact, often raised by means of screw tackle, mounted on a strong waggon bed, and worked by horses; but this is a very rude affair, needing nothing in the way of expensive machinery. Even when the last stump is drawn, and the land has got into the full swing of cultivation, although the resources of modern agricultural engineering may be brought into play, it is not from Great Britain that they will be drawn. Canadian farmers will have nothing to do with English implements, which they consider altogether too heavy and unsuited for their work. They prefer the lighter, cheaper, and handier machines made in their own country or in the United States; and if you urge the cost of repairs, they reply that almost all the parts being in duplicate, there is very little difficulty in replacing them. The same applies to the saws and wood-working machinery as required for the lumber trade; while in general engineering the differences in practice between the two countries are sufficient in almost all cases to determine the choice.

(*To be continued.*)

ELECTRO-PLATING.

By W. Slingo.

XI.

LET us now turn our attention to the deposition of copper upon iron, &c. Very many interesting and pleasing effects may be produced in this way, more especially if the copper film is subsequently coated with another of one of the more precious metals—gold or silver.

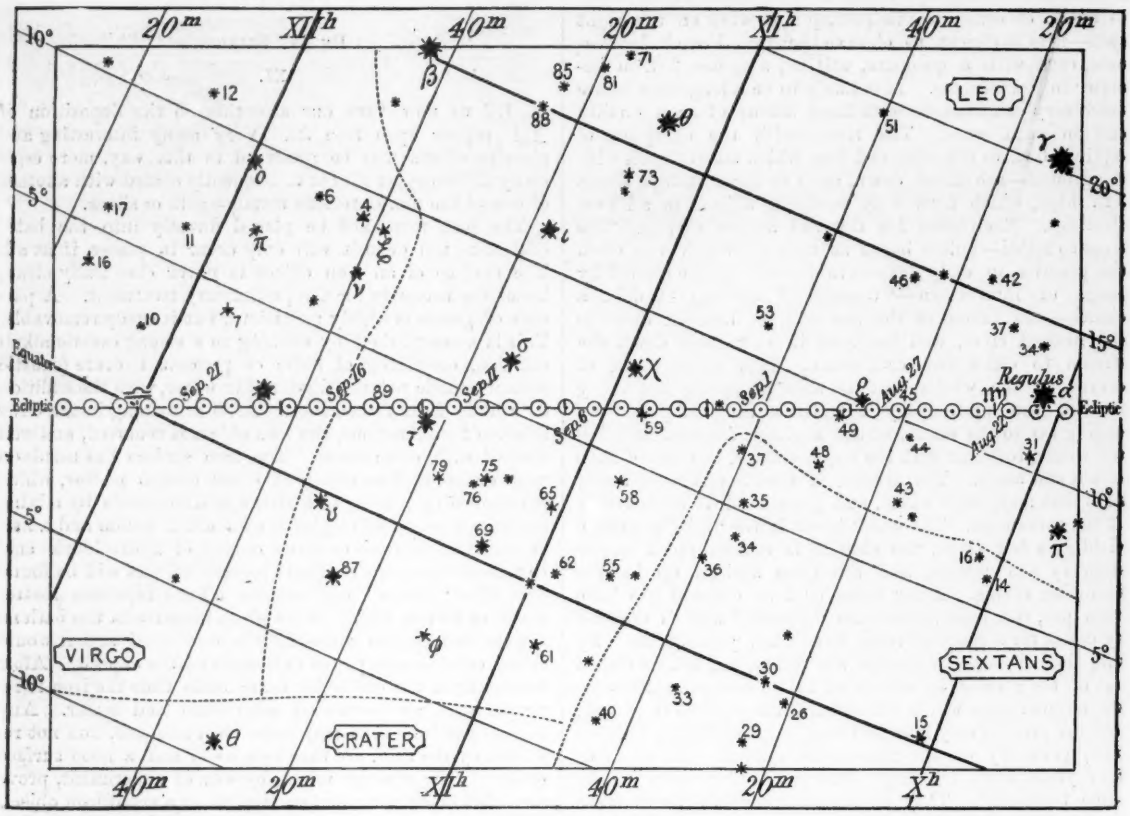
The iron must not be placed directly into the bath, otherwise the deposit will only occur in places, if at all. The surface of an iron object is never chemically clean, hence the necessity for the preliminary treatment. A particle of grease is highly pernicious, but is easily removable. This is accomplished by washing in a strong caustic alkali solution, consisting of sodic or potassic hydrate (caustic soda or caustic potash), dissolved in water, with the addition of a little fresh slaked lime. After remaining in the clear solution for some time, the iron object is removed, and well washed with clean water. The iron surface has besides a more or less copious supply of other foreign matter, which is removed by placing in a vitriol solution made by mixing together a pound of sulphuric acid and a gallon and a half of water, adding two or three ounces of hydrochloric acid to remove the more obstinate impurities. It will be found that this "pickle" will remove all the injurious matter likely to be met with. Were we to immerse in the bath an impure surface, the probability is that local action would ensue, considerably to the detriment of the deposit. After remaining in the pickle for some little time the iron is removed and well scrubbed with sand and water. Any foreign particles that may have been loosened, but not removed by the acid, are thus torn away and a good surface results. The student might, by way of experiment, prove the effect of an imperfect surface, using a small iron object, such as an old key, in a small quantity of solution. This solution should, however, be subsequently thrown away.

The object to be coated is then attached to the negative electrode, and placed in the bath. The solution differs from that used to precipitate copper upon a plumbago or silver surface. Two ounces of sulphate of copper are dissolved in boiling soft water, and after allowing to cool, four ounces of carbonate of potash are added, and two or three ounces of strong ammonia solution. After a time, about six ounces of cyanide of potassium are gradually added, until the blue colour disappears. It is anticipated that some difficulty will be experienced in procuring the cyanide, in consequence of its highly poisonous properties, but it may be obtained in the same way that other poisons are procurable. After allowing to stand for some time, the clear solution is poured off, the precipitate which has formed being left behind.

The object is kept in the solution until a thin but perfect deposit is obtained, when it is removed and placed in the acid solution employed in previous experiments. The reason for this is that in acid solutions, iron, zinc, and other metals are assailable, whence the use of the cyanide solution. When, however, a thin deposit has been procured, there is no longer any necessity to use the cyanide solution, as the object is to all intents and purposes a copper one. It is noticeable that, iron being a good conducting metal, the resistance of the object is very much less than that offered by a substance of a non-conducting nature, coated with plumbago or any other conducting material.

Other solutions might be used, but the above appears to be the best, and answers very well.

Hitherto a pitch-lined wooden bath has answered all



Day Sign for the Month.

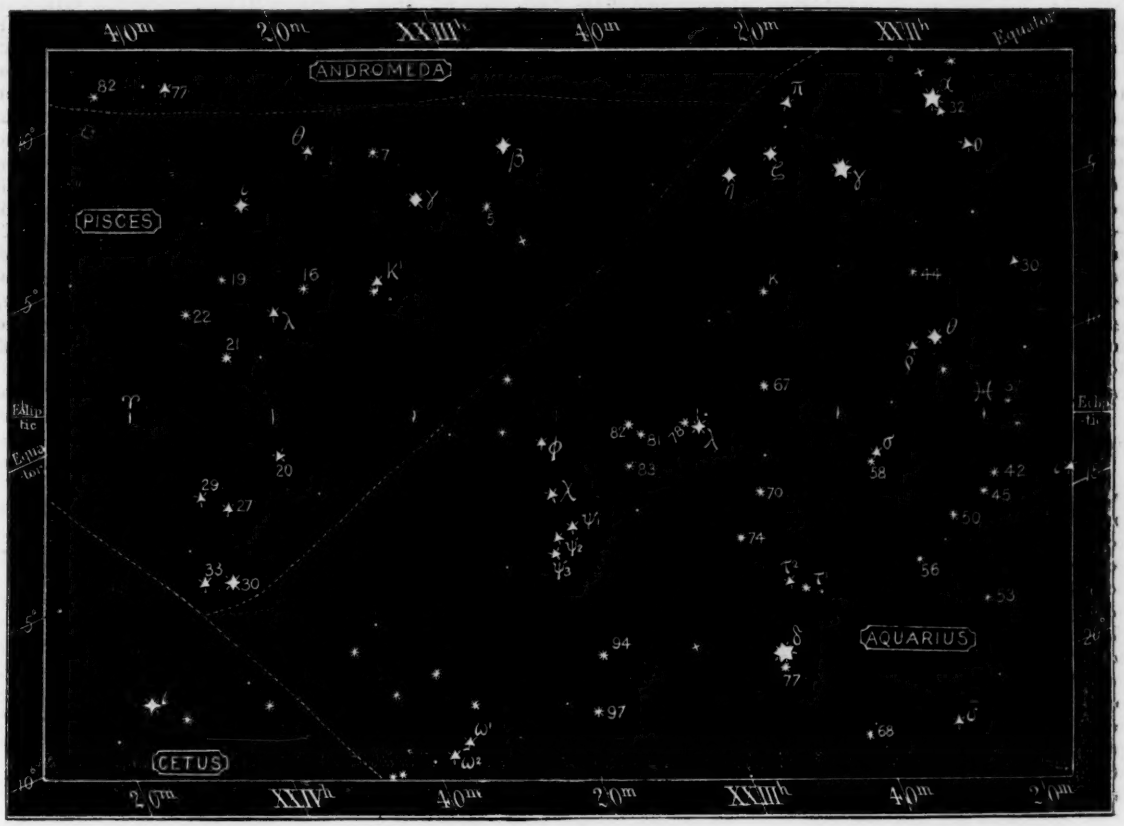
purposes, but when using the cyanide solution a more obstinate material must be substituted. For small objects earthenware pans are useful, but for larger ones enamelled iron is a better material.

The process for coppering zinc is very similar. The metal is first freed from grease by immersion in the alkaline solution, and then placed into a vitriol solution, composed of ½ lb. of sulphuric acid to a gallon of water, no hydrochloric acid being necessary. The remainder of the process is the same as that for depositing on iron, and for like reasons.

To deposit a film of copper upon a glass object, a coating of gutta-percha (dissolved in turpentine) is first applied, to enable the plumbago, which is next brushed over, to adhere. When any difficulty is found on applying the plumbago another process may be resorted to. A pound of tallow is melted and added to two ounces of caoutchouc and a pound of asphalte dissolved in a pint of turpentine. The mixture, after being well stirred, has added to it a solution consisting of an ounce of phosphorus dissolved in fifteen ounces of bisulphide of carbon. When thoroughly mixed, the object is dipped in it, or a small quantity is brushed over the surface. The object is then dipped into the nitrate of silver solution (referred to on page 152), next into a vessel of clean water, and subsequently into a solution of chloride of gold. After being again washed it is allowed to dry, when, the wire being attached, it is placed in the bath, the solution being the same as that referred to in previous articles.

The surface of the copper on being removed from the bath is usually very bright, the appearance, however, being speedily impaired by exposure. Consequently the copper is generally lacquered or bronzed. A fair copper tint may be easily imparted by warming the deposit, and then applying pale lacquer with a camel-hair brush. In bronzing, different colours are produced according to the object operated upon. A brown finish may be imparted by moistening the object with water slightly acidulated with nitric acid, and, after allowing it to dry, heating it gradually until the required shade is produced. If the object require relief, a dark brown film is in this way produced, and then the prominences are brightened by rubbing them with a piece of cloth or leather which has been dipped into liquid ammonia.

These effects, however, are liable to fade, but more permanent effects may be obtained by bronzing. A deep brown tone is produced by rubbing a little rouge, mixed with a small quantity of a weak solution of chloride of platinum, over the copper with a soft brush, and allowing the coating to dry. Another brush, a little harder than the first, is then applied briskly until the necessary brightness is obtained. Variations in depth of colour may be produced by rubbing the bronze off the more prominent parts of the object. A black bronze surface is produced by dipping the object repeatedly in a weak solution of chloride of platinum, or by mixing a small quantity of the chloride with rouge, and then rubbing the mixture over the object with a soft brush, and afterwards with a harder one. Ammonia may be used to lighten the projecting portions of the surface, which should, by the way, be heated before the powder is applied.



Night Sign for the Month.

ZODIACAL MAPS.

By Richard A. Proctor.

WE give this week both the day sign and the night sign for the month, one showing the zodiacal sign now high in the heavens at midnight, the other showing the region of the zodiac athwart which the sun pursues his course at this part of the year.

THE BRITISH ASSOCIATION OF SCIENCE.

LORD RAYLEIGH'S opening address occupied nearly an hour and a half in its delivery. In his opening remarks he mentioned that for more than fifty years the Association held its gatherings in various towns in the United Kingdom, there being few places of any importance which were not visited. Not being satisfied, they sought to conquer new worlds, hence the present meeting in Montreal. When first proposed the project was looked upon with disfavour, as once the thin edge of the wedge was admitted there was no telling to what it might lead. The British Empire being so rapid in its development, there was a prospect of such out-of-the-way places as London and Manchester no longer being able to claim a visit of the Association except as a concession to the susceptibilities of the English. Whatever objections were at first felt were soon overcome by the prospect of the magnificent opportunity of members of the Association becoming better acquainted with the Queen's dominion in this part of the world. He then referred to the loss sustained to science by the death of W. Siemens. The speaker then reviewed the striking advances made of late years in the production and application of electricity upon a large scale, and also touched upon the inventions of the telephone and phonograph.

THEORETICAL ACOUSTICS.

In referring to theoretical acoustics he said: Progress has been steadily maintained, and many phenomena which were obscure twenty or thirty years ago have since received adequate explanation. If some important practical questions remained unsolved one reason is they have not been definitely stated. Everything in connection with the ordinary use of our senses presents peculiar difficulties to scientific investigation—some kinds of information with regard to their surroundings are of such importance to successive generations of living beings that they have learned to interpret indications which, from a physical point of view, are of the slenderest; we are in the habit of recognising without much difficulty the quarter from which a sound proceeds, but by what means we attain that end has not yet been satisfactorily explained. It has been proved that when proper precautions are taken we are unable to distinguish whether a pure tone as from a vibrating tuning-fork held over a suitable resonator comes to us from in front or from behind. This is what might have been expected from an *à priori* point of view, but what would not have been expected is that with almost any other

sort of sound, from a clap of the hands to the clearest vowel sound, the discrimination is not only possible, but easy and instinctive.

In these cases it does not appear how the possession of two ears helps, though there is some evidence that it does, and even when sound comes to us from the right or left the explanation of the ready discrimination which is then possible with pure tones is not so easy as it at first appears. We should be inclined to think the sound was heard much more loudly with the ear which is turned towards than the ear that is turned from it, and that in this way the direction was recognised; but if we try the experiment we find that at any rate with notes near the middle of the musical scale the difference of loudness is by no means so very great. The wave lengths of such notes are long enough in relation to the dimensions of the head to forbid the formation of anything like a sound shadow in which the averted ear might be sheltered.

LANGUAGES AND MATHEMATICS.

In concluding, reference was made to the place the dead languages hold in general education, and the opinion expressed by some that it was monstrous that they should continue to hold such a position. He did not take up an extreme position, but doubted whether an exclusively scientific training would be satisfactory. Where there is plenty of time and a literary aptitude, he could believe that Latin and Greek might make a good foundation. It was useless to discuss the question upon the supposition that the majority of boys attain either to a knowledge of languages or to an appreciation of the writing of ancient authors. The contrary is notoriously true, and defenders of the existing system usually take their stand on the excellence of its discipline. From this point of view there is something to be said. The laziest boy must exert himself in puzzling out a sentence with grammar and dictionary, while instruction and supervision are easy to organise and not too costly. But when the case is stated plainly few will agree that we can afford to entirely disregard results. In after-life intellectual energies are usually engrossed with business, and no further opportunity is afforded for attacking the difficulties which block the gateways. Mathematics, especially if not learned young, are likely to remain unlearned. He would not further insist upon the educational importance of mathematical science, because with respect to them he would probably be supposed to be prejudiced, but of modern language he was ignorant enough to give value to his advocacy. "I believe," said he, "that French and German, if properly taught—which I admit they rarely are at present—would go far to replace Latin and Greek from a disciplinary point of view, while the actual value of the acquisition would, in a majority of cases, be incomparably greater. In half the time usually devoted without success to the classical languages most boys could acquire a really serviceable knowledge of French and German history, and a serious study of English literature, now shamefully neglected, would also find a place in such a scheme.

SCIENCE AND MATERIALISM.

"There is one objection often felt to a modernised education, as to which a word may not be without use. Many excellent people are afraid of science as tending towards materialism. That such apprehension should exist is not surprising, for unfortunately there are writers, speaking in the name of science, who have set themselves to foster it. It is true that among scientific men, as among the other classes, crude views are to be met with as to the deeper things of Nature, but that the life-long belief of Newton, of Faraday, and of Maxwell is inconsistent with the scientific habit of mind is surely a proposition which I need not pause to refute. It would be easy, however, to lay too much stress upon opinions of even such distinguished workers as these. So far as the opinion of a scientific worker may have a special value, I do not think that he has a claim superior to that of other educated men to assume the attitude of a prophet. In his heart he knows that underneath the theories he constructs there lie contradictions which he cannot reconcile. The higher mysteries of being, if penetrable at all by human intellect, require other weapons than those of calculation and experiment. Without encroaching upon grounds appertaining to the theologian's and philosopher's domain, natural science is surely broad enough to satisfy the wildest ambition of its devotees in other departments of human life and interest.

"True progress is rather an article of faith than a rational belief, but in science a retrograde movement is, from the nature of the case, almost impossible. Increasing knowledge brings with it increasing power, and, great as are the triumphs of the present century, we may well believe that they are but a foretaste of what discovery and invention have yet in store for mankind. Encouraged by the thought that our labours cannot be thrown away, let us redouble our efforts in the noble struggle. In the Old World and in the New recruits must be enlisted to fill the places of those whose work is done. Happy should I be if through this visit of the Association or by any words of mine a larger measure of the youthful activity of the West could be drawn into this service. The work may be hard and the discipline severe, but the interest never fails, and great is the privilege of achievement."

LIEUT. GREELY'S WELCOME.

As Section E. was about proceeding to business a couple of tall gentlemen of very unassuming appearance entered the room. One of the strangers, a dark-looking gentleman with a short black beard and side-whiskers, seated himself just inside the door of the antechamber, where he was immediately surrounded and welcomed in an expressive manner by Sir Henry Lefroy and other members of the committee. Sir Henry in welcoming Lieut. Greely said that he, as well as all geographical and scientific men of Great Britain and the whole of Europe, had followed with great interest the efforts made to effect the release of his party, and hailed with the keenest delight their rescue. Lieut. Greely, in reply, remarked that he was delighted at being invited to the British Association, and in attending, and only hoped that he could do more than he would be able to. He would, of course, connect himself with the geographical section principally, and would contribute some of the results of the expedition. In reply to Sir Henry's inquiries, Lieut. Greely stated that the meteorological observations have not been reduced. In an animated manner he proceeded to speak of some of the work done by the expedition. One of the most interesting results will be the comparison of the swinging of the pendulum at the furthest point north reached with that at Washington. He explained that although most of their instruments had to be abandoned, the pendulum apparatus, which weighed 90 lb., was brought back, and has been sent to Washington, where it has been reswung, and comparisons will be made. He remarked, with evident pride, that he had told his party that pendulum was a very important instrument, but that if one man of the twenty-five complained he would immediately abandon it. None would hear of this, and a very important comparison is thus

rendered possible. Speaking of the observation of the temperature, he stated that the lowest temperature ever recorded was experienced in February last, when the mean temperature was 50 deg. below zero.

AMERICAN VEGETATION.

Among the most interesting papers read before the British Association, at Montreal, was one by Prof. Asa Gray, on the "Characteristic Features of North American Vegetation." He said that when the British Association met for the first time on this side of the ocean, it was not to be wondered at that a corresponding member of the association for a quarter of a century should be present to read a paper to the naturalists of Section D. He presented certain outlines of the flora of Canada and the United States as distinct from those in England or the Atlantic coast. The first impression made upon a visitor would be the similarity to the flora of England, many of the plants being almost the same. As one proceeds westward and southward, the differences become more marked. While an agricultural people displaced the aborigines of New England, the flora of Europe also gradually supplanted the plants of the red man. Many of the common plants of the Old World sprang up in the farms, and fields, and roadsides as civilisation proceeded. At almost every step in America the English botanist meets with well-known plants which have found their way from American to English soil. The Virginia creeper, rhododendron, and other well-known plants in England are of American origin. Turning from similarities to differences, an observant botanist on the Atlantic coast would be struck by the liberal number of trees and shrubs to be seen in this section of the country in comparison with England or Scandinavia. The wealth of this flora is an obvious one. The most interesting contrast between the eastern section of the American continent and Europe is the large number of tropical flowers which the heat of the American summer permits to grow in northern latitudes. There are also in this section many of the Arctic plants which remained behind after the glacial period had passed away; the same plants are also to be found in Japan and China, but are wholly wanting in Europe. Europe was at one time much similar to Greenland, which is now undergoing a period of extreme glaciation fatal to flora. In Europe also the glacial period had destroyed many types of flora which had escaped in America. The Arctic flora of America is significant; a few species are found on the cool shores of Lake Superior, the shores of Labrador, and certain mountain summits in the Appalachian mountains.

THE INTERNATIONAL HEALTH EXHIBITION.

XVI.—WATER AND WATER-SUPPLIES—(*continued*).

IN conclusion of our remarks upon the supply of water for domestic purposes, we now propose to give a few simple directions for the benefit of those of our readers who may desire to test their drinking water, so as to be able to decide for themselves whether it is wholesome or unwholesome.

In collecting a sample for scrutiny, one ought to be extremely careful to thoroughly cleanse the vessel used in gathering. A medium-sized glass test-tube or beaker, repeatedly washed, at least three times, with pure distilled water, obtainable from any chemist, may be taken as chemically clean. The sample of water placed in this test-tube ought to be colourless, and free from floating particles, however minute; otherwise it must be regarded as unsuitable. Our senses would probably pronounce the water scathless, and yet it may be highly impure. Its harmful qualities usually arise from the nature of the soil through which it has passed, and the reservoirs, if any, in which it has been detained. It is further liable to be contaminated by its passage along delivery-pipes and its storage in cisterns; hence we find that amongst the injurious products which it may take up, a few are more prevalent than others, and, indeed, are regarded exclusively as the sources of annoyance to the householder. Of these, the presence of—(α) Dissolved or other organic matter in undue proportions may at once be detected by the use of Wanklyn's standard solution of permanganate of potash and potash. Add one or two drops to a test-tube full of the water; if the violet colour of the reagent remains unchanged except in intensity, and does not throw down any sediment even after a lapse of about twelve hours, the water may be looked upon as free from organic matter. If the water is only slightly contaminated, the violet hue will disappear gradually, but foul water will change the violet immediately into a faintly perceptible yellowish brown. The ordinary permanganate test, however, is apt to be vitiated by the presence of harmless nitrous acid, or protoxides of iron, to which it gives up oxygen as readily as it does to albuminoid organic matters. The water ought not therefore to be condemned solely after this test, although it may with justice be looked upon with suspicion. (β) The presence of lead dissolved from service-pipes, especially by waters from non-calcareous regions, may be immediately detected by the addition of one or two drops of a solution of ammonium sulphide to a test-tube full of the water; lead poisoned water will instantly turn brown or dirty in colour; good water will merely diminish the intensity of the yellow ammonium sulphide. (γ) Excess of iron may be demonstrated by the addition of a few drops of a solution of ferro-cyanide of potassium, by which the water will become greenish-blue, more or less markedly according to the degree of contamination. (δ) Too much lime in solution can be shown by the addition of a drop of ammoniac oxalate, when a dense white precipitate will follow. Of course, the less lime there is the less will resultant milkiness be. Ammoniate oxalate also precipitates strontium and barium from solutions, but as these substances do not usually occur in drinking waters they may be disregarded.

All the above-mentioned tests may be carried out by any person of ordinary intelligence,* and will suffice to show the character of the water-supply, and enable the householder to take precautionary measures, if necessary. In all cases, however, where the tests given fail to satisfy the consumer, or to create a suspicion that his supply is unwholesome, we would strongly recommend him to call in the assistance of an analyst, and to apply to the company or supplier for redress. We have shown, in our consideration of the subject of filtration, how extremely bad water may be rendered wholesome; let us hope that those of our readers who are interested in this question, upon which the welfare of thousands of their fellow-beings depends, may be induced to try the few experiments we have just noted, to test their own drinking-water, and, if they find it defective, to select one of the types of filter we have described, to see what it will do for them. We shall be glad to hear of and report their results in future.

* Mr. Maignen, of 22 and 23, Great Tower-street, E.C., supplies a box containing test-tubes, re-agents, and directions, for this purpose.

XUM

THE SOFTENING OF WATER.

Our inquiries into the necessary properties of potable water led us to refer to its softness only incidentally. We have shown that the value of water for the table and the kitchen does not depend essentially upon its hardness or softness. That a very hard water (from 14 to 16 degrees) is undesirable, cannot be disputed; the fur in kettles and the delicate mucous membranes of the human alimentary canal would alike rebel against its extensive employment. On the other hand, we gave as an instance the sad experiences of one of our correspondents, whose parishioners suffered from lead-poisoning, indirectly due to the very soft water of his district. Taking all things into consideration, we deem it advisable that a water, to be thoroughly wholesome for the majority, ought to contain a certain amount (from 5 to 7 degrees or thereabouts) of hardness. The softening processes employed by the water companies of hard-water districts, added to effective filtration, such as that insured by the use of Maignen's "Filtre Rapide," does not leave anything to be desired in a supply of good and pure water for drinking and cooking.

But let us turn for a moment to other branches of the household; we would find not only the laundress and scullery-maid up in arms against us, but we ourselves would feel disposed to admit that they are not unreasonable in their outcries, when we rise to wash with hard water. These inconveniences, however, are but trivial when compared with the serious drawbacks which present themselves to the engineer and manufacturer in a supply of moderately hard water. It would seem somewhat contradictory to state that it is not the hardness *per se* which is objectionable, but rather the presence of the ingredients which cause that hardness. Yet it is easy to show that when the water is merely treated so as to remove hardness without eliminating the causes thereof, such as the introduction of anti-crustation compounds, little or no good follows. As the supply of rain water is a most fluctuating quantity, it cannot be relied upon; and as distilled water cannot always be procured in sufficiency without enormous expenditure, the engineer and manufacturer are forced to look to springs, wells, and rivers for their supplies of water, and to contend against *temporary* hardness, due chiefly to the carbonates of lime and magnesia, and to a less degree to iron, alkaline earths, chloride of calcium, alumina, silica, and silicates; and *permanent* hardness which arises from the presences of the sulphates of lime and magnesia.

In steam-boilers these various products are deposited, and become a constant source of anxiety, in the form of hard incrustations and granular deposits. The former have to be periodically chipped away, or else the boiler would soon cease to act as such, owing to the bad conductivity of the incrustation layer; and if things are neglected still further, the metal plates become heated to redness, the overlaying deposit cracks, the cold water comes suddenly into contact with the red-hot surface, an enormous volume of steam is generated, and the inevitable consequence is a serious explosion. The periodical chipping off of the deposit, too, gives rise to a proportionate wear and tear, which obviously would be saved by the use of water freed from dissolved salts. The granular deposits also help to disturb the tranquillity of the engineer, by wasting his fuel, for they raise the boiling-point of the water in which they are dissolved; and when deposited they have a nasty habit of shifting along the convection currents in the boiler to some inconvenient or dangerous position, where they may behave in a manner analogous to the incrustation explosion. Even where this is provided for by the shape of the boiler, whereby they are forced to occupy some spot protected from the fire, they are prone to blow over as a fine dust along with the steam into the pipes, or even into the cylinders, and then cause dreadful havoc amidst slide-valves and other internal working parts of the engine.

The manufacturers of woollen goods, bleachers, dyers, and others, are all well aware of the evil influences of hard water. It wastes their soap, and keeps their fabrics rough and insusceptible to after-processes. Tanners find that it blocks up the pores of their skins with carbonate of lime, which impedes the subsequent treatment of dyeing the leather, and, by rendering it prone to damp, results in the production of an inferior, unstable article. Sugar refiners, brewers, and distillers are equally alive to the disadvantages of hard water, for not only does it retard the processes of their manufactures, but renders them inferior in quality, and adds to their expense by undue wear and tear of machinery.

In our next communication we shall have occasion to draw the attention of our readers to some of the most valuable and recent advances which have been made in this important branch of the water-supply question, advances which, we are glad to say, are well represented at the Exhibition.

DR. KINNS AND HIS FRIENDS.

In order to remove any possible misconception in connection with Dr. Kinns, I would add to what I said on p. 222, that the testimony of Dr. Birch and Mr. Pinches to the entire accuracy of his *historical* facts is, of course, that of two eminent members of the staff of the British Museum. As Dr. Kinns never professed that they testified to his *scientific* facts, I cannot myself conceive how any suspicion of untruthfulness could ever have been attached to him, whose title to respect is so thoroughly testified to by the names of his committee.

I think that I ought perhaps to add, too, that my description of Mr. Lynn as having "occupied a subordinate position in the Royal Observatory" may have given an inadequate idea of the status of a gentleman who was not only Superintendent of the Altazimuth, but also of the Calculating Department at Greenwich for many years. As an authority on the facts of astronomy, Mr. Lynn is unimpeachable. To him, it will be remembered, is mainly due the reclamation for Cassini of the discovery of the chief division in Saturn's ring, which had been erroneously attributed to Ball ever since the time of Dr. Kitchiner.

And I may further say that, in expressing my dissent from the action of Dr. Kinns's committee, I did so before the reperusal of his work, "Moses and Geology," which has led me to note its perfect accuracy. I therefore now withdraw all I then stated of an unfavourable character, and wish both them and Dr. Kinns God-speed!

Having thus endeavoured to set myself right with all concerned, I am glad to find, by the accompanying note, that Dr. Kinns and his committee are satisfied with my *amende honorable*.—Acting Ed.

To the Editor of Knowledge.

The College, Highbury New Park, 15 Sept., 1884.

Dear Sir,—Permit me to express, on behalf of my committee and myself, our thorough appreciation of the honourable and gentlemanly manner in which you have withdrawn all the unfavourable statements you inadvertently made in reference to ourselves in one or two of your previous editions.—With much esteem,

I am,

Yours most truly,

Samuel Kinns.

Editorial Gossip.

It is with sincere regret that I learn, through a correspondent, of the death of that well-known amateur astronomer, Mr. John Birmingham, of Tuam, which happened on the 7th instant. Mr. Birmingham's name first came before the scientific world as the discoverer, on May 12, 1866, of the wonderful temporary star which blazed up in the constellation Corona. Subsequently we hear of him as an observer of meteor showers. He would then seem to have devoted much attention to the subject of red stars, examining many of the objects in Schjellerup's catalogue for variability. He was also an excellent selenographer, and did good service to science by accurate comparisons of portions of the lunar surface with Schmidt's Great Map, and those of Lohrmann. The work, however, with which his name will be most imperishably connected is his "Catalogue of Red Stars," published in the year 1877, in the "Transactions of the Royal Irish Academy." Avowedly compiled from materials supplied by Schjellerup, Secchi, Huggins, Schmidt, Vogel, Webb, &c., this has ever since been regarded as the standard work on the subject on which it treats. It was but too tardily rewarded by the presentation to Mr. Birmingham of the Cunningham medal of the Royal Irish Academy in January last. He was engaged in his observations of red stars and in the revision and supplementing of his lists up to a very recent period. His lamented death creates a real void among the few workers in his special department of astronomical research.

The compositor has made a violent assault on my English in the first paragraph of the "Editorial Gossip" on p. 221, where the words in parentheses should read: "(and, according to the Irishman's addendum in the venerable 'Joe Miller')."

The result of an enormous mass of work lies before me in the shape of the "Bombay Magnetical and Meteorological Observations, 1879-1882." The voluminous tables it contains are supplemented by diagrams showing the variations of magnetic declination, horizontal force, &c., graphically; and hence in an impressive manner. Mr. Chambers may well be congratulated upon the results of the excellent observations taken under his supervision at Colába.

Another illustration of the wisdom of the aphorism, "Never prophesy unless you know," reaches me in the shape of the announcement of the dismal failure of the (so-called) steering balloon of Captains Renard and Krebs, on the occasion of its second trial on the 12th inst. Instead of the "presque calme" weather in which the first experiment was conducted, a stiffish breeze seems to have been blowing on this occasion, and the balloon—after the fashion of other balloons—simply drifted with it, and had to be towed back to Meudon! Try again, *MM. les aéronauts.*

Reviews.

Dynamo-Electric Machinery. By S. P. Thompson, B.A., D.Sc. (London: E. & F. N. Spon.) With the best efforts of Kempe, Sprague, Prescott, Hoskiœr, and now that of Prof. Thompson, Messrs. Spon are going the right way to get unto themselves the best reputation in electrical circles. Prof. Thompson is perhaps the highest authority we have on dynamos, in practice as well as in principle, and therefore his latest work is sure to be well read. One would almost think that with the flood of books already published on this portion of electrical science, together with the stagnation apparently existing in the electric lighting industry, the demand for another volume would be insufficient to warrant the venture, were it not that the author has chosen a line for himself far and away superior to any other previously adopted. He is not satisfied with general descriptions prefaced by a voluminous dissertation on the history of dynamical electricity, but plunges almost immediately into the subject and carries the reader well through it, embracing all that is at present known of the principle, construction, and government of dynamos and motors. The result is the best work that has yet appeared on the subject.

A Catalogue of Known Variable Stars, with Notes and Observations. By J. E. Gore, M.R.I.A., F.R.A.S., &c. Reprinted from the Vol. IV., Ser. 2, of the "Proceedings" of the Royal Irish Academy. (Dublin: University Press, 1884.)—So far as we have been able to test Mr. Gore's Catalogue, it is an absolutely exhaustive one of all the stars at present certainly known to be variable. The Catalogue proper contains a list and description (in their order of Right Ascension) of 191 stars. In eleven sequent columns it gives the Catalogue number, the star's right ascension, its declination, its change of magnitude, its mean period in days, the epoch of its maximum, the epoch of its minimum, the name of its discoverer and year of its discovery, and finally, in certain cases, remarks on individual peculiarities. This is followed by notes on various objects in the Catalogue, which are both valuable and interesting; in fact, the work summarises our entire existing knowledge of the variable stars in a way upon which it would be difficult to improve. Considering the number of amateurs willing and competent to pursue the observation of the mysterious bodies of which Mr. Gore's volume treats, we think it a pity that so valuable an aid to such observation as he has supplied should be locked up in the archives of a learned society. Astronomers ought to be afforded an opportunity of purchasing such a Catalogue as this.

Sanitary Arrangements of Dwelling-houses. By Mark H. Judge, A.R.I.B.A. (London: Sanitary Assurance Association. 1884.)—Anyone and everyone who contemplates a visit to the Health Exhibition, with a view to obtaining information on the mechanical details of sanitation, may lay out a shilling on Mr. Judge's book very profitably indeed. For what he has done is simply to give a short description of all the various kinds of house drains, closets, soil-pipes, baths, lavatories, waste-pipes, sinks, cisterns, *et id genus omne*, which possess any special merit, in the Exhibition at present open at South Kensington. Just as the "Academy Notes" are confined to the chief pictures of the year, so our author's pamphlet points out all that is best worth seeing in connection with sanitary appliances; with, though, an occasional reference to some contrivance conspicuous for its faulty principle, as a foil to more scientifically devised ones. To those who merely go to the Show to eat and drink and hear the bands play, this pamphlet will possess but small interest. To those who visit it as a *Health* Exhibition, Mr. Judge will be found a trustworthy guide.

The number of visitors to the International Health Exhibition on Monday was 55,971, raising the total since the opening to 2,753,027, and thus passing the total number of visitors to the Fisheries Exhibition last year, which was 2,703,051. The Health Exhibition has been open 112 days; the Fisheries was open for 147 days. The daily average up to the present of the former is 24,580, that of the latter during its entire term was 18,388.

XUM

Miscellanea.

A curious barometer is said to be used by the remnant of the Araucarian race which inhabits the southernmost province of Chili. It consists of the cast-off shell of a crab, which, from its curious application, is called the "Barometro Araucano." The dead shell is said to be extremely sensitive to atmospheric changes, remaining quite white in fair, dry weather, but indicating the approach of a moist atmosphere by the appearance of small red spots, which grow both in number and in size as the moisture in the air increases, until finally, with the actual occurrence of rain, the shell becomes entirely red, and remains so throughout the rainy season.

To Remove Foreign Bodies from the Eye. — Before resorting to any metallic instrument for this purpose, Dr. C. D. Agnew (*American Practitioner*, May, 1884) would advise you to use an instrument made in the following manner: Take a splinter of soft wood, pine or cedar, and whittle it into the shape of a probe, making it about the length of an ordinary dressing probe. Then take a small, loose flock of cotton, and laying it upon your forefinger, place the pointed end of the stick in the centre of it. Then turn the flock of cotton over the end of the stick, winding it round and round, so as to make it adhere firmly. If you will look at the end of such a probe with a two-inch lens you will see that it is quite rough, the fibres of cotton making a file-like extremity, in the midst of which are little interstices. As the material is soft, it will do no harm to the cornea when brushed over its surface. When ready to remove the foreign body, have the patient rest his head against your chest, draw the upper lid up with the forefinger of your left hand, and press the lower lid down with the middle finger, and then delicately sweep the surface in which the foreign body is embedded with the end of the cotton probe. When the foreign body is lodged in the centre of the cornea it is most important not to break up the external elastic lamina, for if you do opacity may follow, and the slightest opacity in the centre of the cornea will cause a serious diminution in the sharpness of vision.

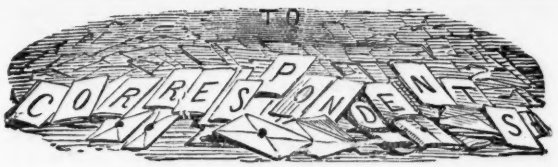
A Distilling Insect.—Livingstone met with a wonderful distilling insect in Africa on fig-trees. Seven or eight of the insects cluster round a spot on one of the smaller branches, and these keep up a constant distillation of a clear fluid like water, which, dropping to the ground, forms a little puddle. If a vessel is placed under them in the evening, it contains three or four pints of fluid in the morning. To the question, whence is this fluid derived? the natives reply, that the insects suck it out of the tree, and naturalists give the same answer. But Livingstone never could find any wound in the bark, or any proof whatever that the insect pierced it. Our common frog-hopper, which before it gets its wings is called "cuckoo-spit," and lives on many plants in a frothy spittle-like fluid, is like the African insect, but is much smaller. Livingstone considers that they derive much of their fluid by absorbing it from the air. He found some of the insects on a castor-oil plant, and he cut away about twenty inches of the bark between the insects and the tree, and destroyed all the vegetable tissue which carried the sap from the tree to the place where the insects were distilling. The distillation was then going on at the rate of one drop in every 67 seconds, or about five and a half tablespoonfuls every 24 hours. Next morning, although the supplies of sap were stopped, supposing them to come up from the ground, the fluid was increased to one drop every five seconds, or one pint in every 24 hours. He then cut the branch so much that it broke, but they still went on at the rate of a drop every five seconds, while another colony of the insects on a branch on the same tree gave a drop every 17 seconds.—*The World of Wonders.*

Intelligence of the Oriole.—On the western side of Central Park, very near 103rd-street and Eighth Avenue, stands a row of elm-trees, difficult to approach on account of a heavy growth of syringa bushes around them. On a branch of one of the trees, about 16 ft. from the ground, a pair of Baltimore orioles set to building a nest a few weeks ago. They chose the extreme end of the bough, with evident intention of making it a hazardous experiment for any bird-nester to attempt to molest them. But in their excess of caution they appeared not to observe what the few persons whose eyes were keen enough to see the first labours of the little architects saw—that the branch was much too slender to support so large a nest as the oriole builds. When the nest was about two-thirds finished the birds saw their mistake. The branch had bent so low that it was getting perilously near the grass. Work was at once stopped, and the builders sat close together for a long time, and seemed to be discussing the situation. Finally, they flew side by side to a bough about 15 in. over the one on which their nest was, and, leaning over, inspected the distance. They seemed to be satisfied, and, though it was growing rapidly dusk, the birds flew away in opposite directions. In the morning it was found that they had firmly secured their habitation, and prevented the branch from bending lower, by passing a piece of white string, which they had found somewhere in the park, over the upper bough, and fastening both ends of it securely to the edges of the nest. The building then went rapidly on, and the orioles are now engaged in hatching their eggs. Very few persons have seen the nest, and there is a fair prospect that their skill and ingenuity will be soon rewarded by a brood of young orioles.—*New York Sun.*

A Mountain of Alum.—Mr. G. M. Shaw, of this city, has just returned from a month's trip to the Gila River country, in the south-western portion of Socorro County, where he went with Messrs. Brown and Bergen to survey and report on the recent alum discoveries there, which have been located by a company of Socorro citizens. Mr. Shaw reports almost a solid mountain of alum over a mile square, some of the cliffs of which rise to an elevation of 700 ft. above the river bed. Most of the alum is in an impure state, and tasting very strongly of sulphuric acid, but of which there seems to be an inexhaustible quantity. Some of the cliffs, however, show immense quantities of almost pure marketable alum. This alum-find, Mr. Shaw tells us, is on the Gila River, about two miles below the fork of the Little Gila, and four miles below the Gila hot springs. Mr. Shaw reports numerous hot springs in that section, most of them gushing out of the rocks that form the river banks, some of them hot enough to cook in, and most of them too hot to hold the hand in. The main hot springs referred to above are reported to have effected wonderful rheumatic and other cures. The country is abundantly watered and wooded, and is covered with the finest of grass. The Gila is full of trout and other fish. Game, while still moderately plentiful, has been mostly scared away from the region of the hot springs by professional and other hunters, as well as ranchmen, who are beginning to locate in this difficult-to-get-at section of the Gila. At present the only way to get into this section is with pack animals over a precipitous trail of several miles, waggons having to be abandoned in the gorge of the Little Gila on the North Star Road, about two miles from the hot springs and about seven miles from the alum find, going from Socorro or from the Black range. By the way of Silver City and Georgetown wagons are abandoned on "Sapio" Creek, with about eighteen miles of pack animal trail to the hot springs. Mr. Shaw being an amateur photographer also, invariably carries his "outfit" on his surveying trips, combining pleasure with business, and bringing back with him photographs of all objects and scenes of interest that he meets with on the way. He brings back from this trip over sixty photographs of the Gila country, among which are a number of exterior and interior photographs of some interesting cliff-dwellers' ruins he encountered in a cave about four miles west from the hot springs.—*Socorro Bullion.*

American Engineering Models for a Japan University.—The Imperial University of Tokio, Japan, reorganised in 1860 as the successor of the old Imperial Observatory, founded in 1744, is evidently pushing forward in that full accord with the spirit of modern progress which the Japanese Government has shown in so many ways since the old exclusive barriers were broken down. A notable instance of this is found in a recent order for models, sent by the authorities of the Tokio University, to be built at the engineering school-shop of Vanderbilt University at Nashville, Tenn. The order embraces the following:—A model of wrought-iron highway truss bridge, 6 feet in length, to be built in brass; a small working compound steam-engine, with expansion gear and reversible gear; a small working iron turbine waterwheel, with water governor and sluice-gate; two differently constructed cast-iron models of steam-engine pistons with metallic packing rings; a working model of engine's slide valve and expansion valve with adjustments and appliances for indicating the relative positions of piston and valves at any part of the stroke; a working model of a surface condenser for a compound engine; a working model of an improved pendulum governor for steam-engine, with adjustment for regulation of throttle-valve. The order for the truss bridge was accompanied by working drawings in blue print, but the other pieces are to be designed as well as constructed at the Vanderbilt University. The work will be commenced at the school-shops with the opening of the fall session, and will afford the best of practice for the engineering students, of whom the class is so large that it is proposed to make duplicates of the articles ordered, that one set may be kept. Instruction at the Tokio University is in Japanese, except in the Schools of Law, Chemistry, Engineering, Polytechnics, and Mining, in which the instruction is in English. The School of Engineering is under the charge of Prof. J. A. L. Waddell, an American engineer.—*Scientific American.*

XUM



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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TEA AND COFFEE.

[1397]—I quite corroborate the statements of Mr. Williams with regard to the imbibition of tea and coffee, and the manner in which they affect the constitution. For years I was accustomed to drink freely of both; it had become, of course, quite a habit, and one not easy to shake off. Three months ago I left off drinking both, and, although I missed them at first (suffering from frequent headaches and irritability), I now, and for the last two months or more, have never felt better in my life or more fit for mental labour. I always drink hot milk in place of these unnecessary stimulants, and I know of no better restorative after any kind of work. The boiling of the milk destroys any germs that might exist in it. Tea or coffee after dinner in the evening always had the effect of keeping me awake at night, thus showing the powerful way in which they act on the systems of some people. I believe stimulants of all kinds to be quite unnecessary, excepting in certain cases of illness. As for mustard, cayenne pepper, and such-like condiments, I do not think it advisable to let the coats of one's stomach be subjected to sensations that one's tongue can scarcely endure.

C. CARUS-WILSON.

FIGURE PUZZLE.

[1398]—I have met with the following figure puzzle; can any of your readers solve the same?

Let A B C D E F equal the number.

Then B C D E F A will be three times the original number;

C D E F A B	,,	double	,,	,,
D E F A B C	,,	six times	,,	,,
E F A B C D	,,	four ,,	,,	,,
F A B C D E	,,	five ,,	,,	,,

E. SIDDER.

FALSE PERSPECTIVE.

[1399]—If I do not trespass too much on your space and patience, I shall be glad if you will kindly insert the following in answer to your correspondent, "J. H. D." (No. 1386.)

If an object at A appears smaller than a similar one of equal size at B, *because* it is further off, so likewise, and for the same reason, will it appear smaller than B when it is moved to *b*.

The painter must depict things as they *appear to the eye;* it is for the sculptor to represent them as they exist in nature.

R. JONES.

[1400]—I suppose that "R. R." and "J. H. D.'s" explanations will convince R. Jones that the accepted method of drawing horizontal lines parallel to the picture plane is correct. Many beginners in perspective and persons unacquainted with the subject entertain his idea. The example which R. Jones gives in his letter, No. 1384, is one that is sometimes called parallel perspective, which, like all perspective, supposes the eye to be fixed and directed at right angles to the picture plane, the picture being limited to the base of a cone, whose apex at the spectator's eye is an angle of 60°. If he will look at the street under these conditions, he will observe no perceptible trending away of the horizontal lines, parallel to the picture plane. On his principle, the vertical lines would also seem to vanish, skywards or earthwards, according as his position was low or high. He may rest assured that if either the horizontal or vertical lines have vanishing-points, they are at an infinite distance, and that there is no more occasion to represent any inclination than there is to consider the rays from the fixed stars other than parallel. As soon as he turns his eye up or down the street, the picture plane, which is at right angles to the central visual ray, moves round too, the horizontal lines are no longer parallel to it, and the street is then in angular perspective, and the top and bottom edges trend away to their respective vanishing-points in the horizontal line.

EYE-WITNESS.

[1401]—In case no one else has replied to Mr. T. E. Jones's letter in your number of August 15, I would point out that his reasoning is defective. According to his argument the projection of the line of posts, if produced both ways, would converge both to left and right, the line of tops, thirdly, forming an angle at the centre, and we should have a case of a projection of a straight line on a plane consisting of two straight lines meeting at an angle, which is impossible. The real fact is that, in the case supposed, where the axis of sight is at right angles to the plane of the line of posts, the latter all actually appear to the eye to be of the same length equidistant. This follows as a geometrical consequence of the plane of projection being parallel to the plane of the object. Anyone can verify this by examining a photograph of a building in which the camera has been pointed square to its front, as it were. It is only when the camera (or the eye) is turned obliquely to the line of posts that their distances diminish in proportion, and their parallel lines converge.

MUSAFIR.

Canada, 29th August.

CLEMENTS' WEATHER CYCLE.

[1402]—As I found the node-cycle of the moon did not quite satisfactorily account for the recurrence of rainfall at London, I combined the apse-cycle with it, obtaining a 10·3 years' cycle by finding the product of one-fourth of each of these cycles, the moon's orbit and the nodes and apses of 18·6 and 8·85 years respectively being divided into four well-marked portions. And as this combination-cycle somewhat imperfectly accounted for the London rainfall, I combined with it the London tide-cycle, which I had just accidentally discovered, thereby changing the 10·3 into a 20·35 years' cycle, by multiplying by 1·98 the fourth of 7·92 years, the time occupied by the tidal revolution. This 20½ years' cycle accounts for the London rainfall so satisfactorily that there is little or nothing further to be desired. In fact, the nodal and apsal cycles account for the general terrestrial rainfall, and the local tidal cycle satisfactorily accounts for the local variations. As the successive position of these cycles can be determined with absolute precision for the future as well as the past, the rainfall at London and elsewhere can be predicted with much certainty for any number of years in advance. From this cycle we may obtain a multiple cycle of 61 years, and the intervening cycles of 30·5, 40·7, and 50·9 years, with a sub-cycle of 10·175, or nearly 10·2 years. From the 20½ years' cycle, it will be observed that the wet and dry years, together with those of an average rainfall occur in the same part of the cycle respectively with great regularity. For instance, 10¼, 20½, 30¾, 40⅘, 50⅘, 61, and 71⅓ respectively, added to the wet year 1821, give the wet years 1831, 1841, 1852, 1862, 1872, 1882, and 1892, and, deducting the same figures successively from the present dry year, 1884, we obtain the dry years 1874, 1864, 1854, 1844, 1834, 1823, and 1813. with a similar result any year may be taken and the additions or deductions made. Coming to the near future, it may be seen from the diagram that the years 1894 and 1895 will correspond with 1873 and 1874, and that the years between will be dry or mean except 1885, 1889, and 1892. In fact, the weather in England repeats itself every 61 years, and I have verified this repetition down to the commencement of the Christian era.

HUGH CLEMENTS.

[I insert Mr. Clements's letter without possessing the slightest faith in his system. But *ars probat artificem*, "the proof of the pudding is in the eating." He makes definite vaticinations of rainfall and drought, and it only remains to be seen whether they are fulfilled or not.—ED.]

AËRIAL LOCOMOTION.

[1403]—Your recent articles treating on air-navigation I have read with great interest. Still, I think you have omitted the most important name in the list of those credited with aiding the problem of flight to a solution. I refer to Charles Darwin, and instance his observations on the condors of South America given in his "Naturalist's Voyage Round the World," written nearly half a century ago.

I entirely agree with you in holding that the possessor of "vague notions" about how birds fly is not likely to lead to good results in aërostatics, and you will doubtless agree with me in thinking that very *precise* and *correct* notions on that subject might well be invaluable.

It is obvious that every notion in regard to flying now the property of man has been derived from the birds. Had it not been for the flapping birds no one would ever have adopted the notion of using active force, such as muscular, steam, or any other known to us, to urge his way into the unresisting air.

This was done by Darwin in the book above quoted; and it is a constant astonishment to me that no Englishman has seen the significance of his observations, and, as a consequence, placed the human race in the air.

The condor is a strong bird, some fifteen feet in alar dimensions, weighing twenty pounds, and having a stomach capacity for five pounds of carrion. Darwin says it cannot flap itself off of the ground, but has to run into the air; and if surprised before having time to indulge in a short foot-race, is easily captured.

What chance, then, is there for a man to flap himself into success when the best specialised animal extant in this direction is unable to do it? Man has no specialisation in that direction, and weighs four times as much.

Darwin goes on to say that this bird, once in the air, moves with astonishing grace and ease, traversing the air at will in any direction, without flapping at all! He is emphatic on the point of rigidity of pinions, and I submit that, coupling these two facts, they far outweigh in value all experiments tried by man in this field.

For they show that with the large, heavy birds "flapping," or, in other words, active force, is not a factor in flight, and the whole question is shifted to other grounds, and the usual conception of "flying" completely changed. It becomes possible, with the light thus shed upon the problem, to throw it into a proposition of general terms, which may be thus stated:—

Flight is the result of the distribution of weight and position in relation to atmospheric air. If Darwin has rightly stated the facts, that is about the state of the case. Active force is eliminated. So far as the bird is concerned, it simply *does nothing*, and for *doing nothing* a man is as admirably specialised as any creature on earth. Whatever bugs, bees, and beetles may do in the way of flapping—however humming-birds, tomtits, kestrels, kites, and other small fry manage to get about—is beside the question. There is nothing discoverable about them which man may hope to imitate. But if Darwin is right, there most surely is about a condor, and because he so clearly observed and recorded these facts, I suggest that you should have admitted him into the circle of the promoters of aërostatics.

Every item of advance mentioned which may buttress hopes for successful flight is fully anticipated by this English naturalist fifty years ago. He pointed out that a body weighing 25 lb., with a certain distribution of weight in given dimensions, is sustained in air, and translated in any direction, with or against the wind, and in opposition to gravity, without the employment of any active force whatever. 'Tis true that this fact needs an explanation. But bear in mind that an *explanation* is all that it does need. The *fact*, there is no doubt about, and why the experts of a country able to produce a Darwin have not long ago supplied that explanation is humiliating. J. LANCASTER.

Chicago.

MIND AND BRAIN.

[1404]—In reference to the assertion of Professor Büchner, in "Force and Matter," that the molecular change or vibration in the brain, which accompanies every thought, *is* thought itself, I venture to ask the following question:—What is the power which *determines the nature* of such molecular changes; *compelling* the brain itself, by what we call an effort of will, without the aid of the association of ideas, to evolve, at one instant, a thought (*e.g.*) respecting theology; at the next, one in classics or mathematics; at a third attempt, on some wholly different subject. Must there not, in fact, be some controlling power, distinct from the brain itself, which uses the brain as its instrument in the production of thought, and thus effects the molecular changes?

To me it appears indisputable that Professor Büchner mistakes effect for cause. S. F. B. PEPPIN, Vicar of Herrington.

[Mr. Peppin's is a query so pertinent that I insert his letter at length.—ED.]

SHOOTING STARS.

[1405]—I see by Letter No. 1389 of your issue of the 12th inst., Mr. W. H. S. Monck thinks that certain shooting stars, after vaporisation in our atmosphere, may solidify again outside it, while others may pass through it, without being reduced to meteoric dust. Further, that these bodies may, in future, revolve round the earth as a centre, instead of round the sun. If such be the case, and if Saturn's rings consist of an infinite number of small satellites, the earth, I take it, would by this time be provided with a similar appendage, visible to man, unless the myriads of meteors so revolving, which must have accumulated in the course of ages, could be present without reflecting light. If this be impossible, the inference is, I submit, that none escape disintegration, or, if they do, their orbits are not so affected as to make them play the part of satellites to our planet. EYE-WITNESS.

SHIPS' LIGHTS.

[1406] — Having lately commenced to take KNOWLEDGE, in monthly parts (I am sorry I did not commence sooner) I read with much pleasure your able article headed "Sent to the Bottom."

I have hundreds of times felt keenly what you say in that article, viz., that the present system of signals at sea tells little or nothing even when they are seen, and they ought to be so arranged as to tell us everything that can be told by signals about the position of ships and the courses they stand upon.

Going along among a lot of vessels, steam and sail, going in different directions *in daylight*, we can thread our way easily as long as every one keeps the steering rules, because we can see exactly which way every vessel in sight is heading, but the moment darkness sets in uncertainty "reigns supreme," although the weather may be clear enough for us to see all the lights within our limits. Many a time in crowded waters I have stood on deck the whole night with my teeth set, and my heart in my mouth most of the time—especially when I had charge of a sailing vessel—where I had not the power to stop and reverse, seeing a number of lights about me which told me but a mere fraction of what was necessary for me to know, in order to go along safely.

If those at the head of affairs were to turn their attention to such matters as these, their praiseworthy efforts to diminish the loss of life at sea would, in my humble opinion, be crowned with more success than any other way they can take. Let them, by legislature or otherwise, give us ships so constructed and equipped as to give us a fair chance to avoid danger, and the instinct of self-preservation will do the rest.

It is, indeed, surprising, as you say, that matters are allowed to proceed for a single month without change.

Your plan, in my opinion, is so simple, that any one with brains enough to make him fit to take charge of a vessel for a "watch" can master it in half-an-hour, and the sooner the present system is unlearned the better. M. P.

S.S. *Prydam*, Aug. 3, 1884.

PRINCE KRAPOTKINE'S CAT.

[1407]—The question being to what extent a cat is affected by her reflection in a mirror, Prince Krapotkine writes to the *Revue Scientifique* that his cat of fourteen months old, which he has reared during his imprisonment, when he perceives his image even in a hand-glass, will assume a serious air and endeavour to touch it with his paw. Then, meeting the surface of the mirror, he makes for the back of it, evidently fancying another cat is behind a pane of ordinary glass. If the mirror be withdrawn he will follow it up until he assures himself there really is no other cat behind; and then he walks off, and will pay the matter no further attention. This cat does not mew to have the door opened, but stands on his hind legs, and shakes the latch with his fore-paws. He knows the prison-bells, such as those for rising in the morning, and the various meals. When the well-known prisoner takes his evening walk up and down his room, the cat goes through all sorts of antics, and makes a lot of little purring noises to obtain a game of hide-and-seek, with which he is not pleased unless his master takes his turn in hiding too. He understands a few words. When he wants to play with his string, if asked, "What do you want? Food? A drink?" (*manger, boire,*) he gets huffed and walks away; but the moment the word "string" (*ficelle*) is pronounced, he makes two little sounds which clearly mean "Yes." J. O'N.

RAILWAY ACCIDENTS.

[1408]—I have read with very great interest the valuable details relating to continuous brakes and railway accidents which have appeared in your columns, and I am extremely glad to see this important subject so fully discussed. There is no doubt that the general public does not understand the most important point in the whole matter. The usual opinion appears to be that "a brake must be a good train-stopper." The fact is, an efficient continuous

brake is required not only to be a first-rate train-stopper in ordinary every-day use; but, what is far more important, it must be a self-acting, life-saving appliance, in case of accident similar to the one at Penistone. It is quite useless to suppose that the locomotive engine, railway rolling stock, or permanent way, can ever be made free from defects and consequent failures. During the first half of the present year no less than 568 tyres, 171 axles, and 181 rails failed, and 28 cases occurred of passenger trains, or parts thereof, leaving the rails, by which 7 persons were killed and 51 injured. When we consider that the fearful disaster at Penistone was caused by the breaking of one axle, the fact that no less than 171 axles broke in six months becomes a matter for serious reflection. Axles may be made of the finest materials by the very best of makers, yet flaws may and do grow, which neither the closest examination nor care can detect. In the same way rails break without giving any warning or showing any previous flaw. Under these circumstances the great question is, What can be done to mitigate or counteract the disastrous effects of these failures of material, and render them as harmless as possible? To this question there is and can be but one reply—viz., the adoption of a life-saving appliance in the form of a quickly-acting automatic continuous brake. An express train running at sixty miles an hour passes over a space of 86 feet per second. If the brake can be instantaneously applied, the train runs but a few feet before the retarding power comes into full operation; but in the case of a slowly acting system, which takes six or eight seconds, the train runs four or five hundred feet before the brake power can be brought into action, and this simply means that the train is dashing along at full speed, perfectly out of control, at a time when a quickly-acting system would have very materially reduced the speed and minimised the danger and risk. As long ago as August, 1877, the Board of Trade issued a circular to the railway companies, in which the essential conditions to a good brake were clearly laid down. The most important condition is that the brakes are, "in case of accident, to be instantaneously self-acting." To fulfil this, the brake must be what is known as automatic. A "simple" brake has no store of power, it is only used when required to make a stop, and there is always the fear that when it is required it will be found wanting; and again, even if it be once applied it comes "off" of itself, as was the case at Penistone, just at the very moment when most necessary to prevent the train running down the embankment.

The General Report to the Board of Trade upon the accidents during the year 1883 has just been issued, and shows that nine accidents were due to want of continuous brakes, five to the want of quickly-acting continuous brakes, seven to continuous brakes on the trains not being connected with the engine, two to the guards not being able to apply the continuous brake; whilst in eight instances the action of automatic or other continuous brakes are reported to have done good service in either preventing the collisions altogether or in reducing the shock occasioned thereby. The accident near Lynn on Wednesday is a very important case in point. A train ran off the line; the Westinghouse automatic brake brought it to rest without the loss of a single life. Had this train been provided with a brake which did not fulfil the Board of Trade conditions, a serious disaster must have followed. Such facts require no comment.

CLEMENT E. STRETTON, C.E.,
Leicester, Sept. 8. Hon. Mem. A.S.R.S.

COINCIDENCES.

[1409]—When on ten days' leave at Agra, during the rains of 1875, I actually dined at mess one night with Smith, Jones, Brown, and Robinson. Only nineteen men sat down to mess. Brown was the General commanding the division, Jones was his Brigade-Major, Smith was an officer of the 55th going through the garrison class. I forget who Robinson was, but, as if to make the coincidence complete, Robertson, of the Central India Horse, was also present.

At the same time I noticed another coincidence in connection with three uncommon surnames and multiples of nine. It was as follows, the names being those of three European officers, the regiments three Bengal infantry ones to which the officers respectively belonged:—*Regiment*, 9th B.I., 18th B.I., 27th (?) or 36th (?) B.I. *Officer*, Capt. Toke, Capt. Toker, Dr. Stoker. With the increase in the number of the regiment there was an addition of a letter to the root name. C. W. S. D.

THE BEST FORM OF TRICYCLE.

[1410]—In reply to your correspondent "A. H." (1386), I regret that I have not seen or heard of a tricycle known as the Coventry Compressus. It may well be that after more than 300 machines have been brought out I may have missed one. The only machine I have heard of as the Compressus was one made by Moore, of Kennington Park. This was a convertible, with *two* front-steering wheels. It had good points, among which were these: that it was very safe from capsizing, and it was a two track machine. I do not think this make of machine can now be purchased.

I have not cared for any of the Merlin Tricycles, but as many different forms of machine have been brought forward under that name, I do not know which form "A. H." refers to.

JOHN BROWNING.

LETTERS RECEIVED AND SHORT ANSWERS.

E. R. I do not possess Mr. Wright's book, and, in the absence of the context, speak with some hesitation. If, though, we take a crystal of Iceland spar and tilt it in a certain direction, a dot of ink or a spot of light, as viewed through it, appears double; but as we turn the crystal the two images, after separating to a fixed distance, begin to approach, and ultimately coincide. This being understood, if we view the two images through a second crystal in a certain position, each of such images suffers duplication, giving four. If, now, we turn crystal No. 1 round until *its* images are fused into one, this one becomes only two in the second crystal, and on the second crystal assuming a proper position the two images in it become, as in the first case, united in one.—A. Z. For "the full meaning" of Protoplasm and Bioplasm you must consult the works of Professors Huxley, Haeckel, and others.—C. DONOVAN. Thanks for proffered articles, but Ferrier and others have conclusively shown that the Phrenology of Gall and Spurzheim is absolutely baseless. See Carpenter's "Mental Physiology," Bastian's "Brain as an Organ of Mind," &c.—NATH. ALCOCK. If you like to send a short *précis* of your views on the subject of the "Colours of Tropical Man," I shall be glad to print it, but I cannot merely reproduce what has appeared in contemporary columns.—JOHN HOWELL. Thanks; but such a poem as you forward is wholly unsuitable for these columns. —T. BROWN. "The Stars in their Seasons" is published by Longmans & Co., London.—J. O. LINDSAY. Many thanks.—GUERY. Such halos as you describe round the moon are caused by the refraction of her light through a mass of minute ice-spicules, formed in the region of the cirro-stratus clouds some 20,000 ft. high. If you measure the angular diameter of such halos, you will find that they generally have a radius of about 22°. The brush-like appearance may have been caused by more opaque intermediate clouds of small size intercepting the moon's light, in a way akin to what happens when—as the country people say—"the sun is drawing water."—DR. E. GROTH. Forgive me if I say that I cannot spend an hour or two in plodding through my astronomical bookshelves. I may just ask you (after taking down a very few books at random) to see Newcomb in "Monthly Notices of the R.A.S.," Vol. XXI., p. 55, and the same author's "Popular Astronomy;" also Beckett's "Astronomy without Mathematics." I have a much more detailed mathematical disproof of Olbin theory somewhere, but I am unable to light upon it just now.—THANKS. The colours produced by absorption are not simple, and the chances are that your "blue" glass was of a purple tint. The eye, too, is far from being achromatic. To definitely answer your question the lantern-glass should be examined by the spectroscope. No doubt particles of sand or dust might be compressed into solid blocks by pressure; but no theoretical answer can be given as to the amount of that pressure, which must be the subject of direct experiment.—ANONYMOUS. Do you seriously suppose that I am going to notice a tract which speaks of men of eminence and honour in the medical profession as "the real wire-pullers—the Simons, Corys, Seatons, and similar discredited and mischievous blunderers"? If blatant abuse were argument, Anti-Vaccinators must have had it all their own way long enough ago.—BOREAS. No one replied to your query, and I was unable to do so myself. I cannot believe that your *jeu-d'esprit* would be any more successful in eliciting information.—JAMES SHONE. If you refer to page 437 of the previous (5th) volume, you will find there an almost complete answer to your question. I have every faith in the institution, and am fully assured that every honestly competent pupil may rely upon securing good employment, more especially if foreign service is agreeable. You might, however, learn this and more by paying the place a visit.—Dr. J. G. DAVEY sends me a pamphlet intended to show (from mesmeric experiments!) that Gall and Spurzheim's phrenological system of mapping the brain is the only true one; and that the experiments of Ferrier, &c., and the opinions of all the most eminent modern psychologists are worthless. He must not be angry with me if I say that he has wholly failed to convince me of this.—D. SUTHERLAND. Thanks, but rather outside the range of subjects embraced by this journal.—F. MINTER. Will be resumed in due season.—T. COMMON. I would gladly insert your really admirable letter; but if you only knew what piles of (unprinted) correspondence the subject has brought, you would pity as readily as you would excuse me.—W. T. LYNN. You are perfectly right. The "if" was, at least, as ridiculous as it appears in either of your illustrations. See this week's "Gossip."—C. E. S. The "Bab Ballads" originally appeared in *Fun*.

XUM

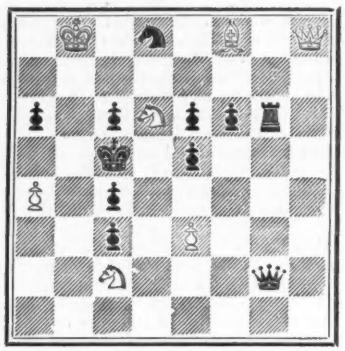
Our Chess Column.

By Mephisto.

PROBLEM No. 129.

By I. G.

Black.



White.

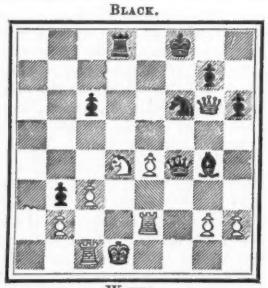
White to play and mate in four moves.

VIENNA GAME, PLAYED AT ST. LOUIS, U.S.A.

White. Dr. Zukertort.	Black. Mr. Max Judd.
1. P to K4	P to K4
2. QKt to B3	B to B4
3. P to B4	P to Q3
4. Kt to B3	KKt to B3
5. B to B4	Castles (*a*)
6. P to Q3	P to B3
7. Q to K2	P to QKt4
8. B to Kt3	P to QR4
9. P × P	P × P
10. Kt × KP (*b*)	P to R5
11. B × P (ch)	R × B
12. Kt × R	K × Kt
13. B to Kt5	P to Kt5
14. Kt to Kt sq. (*c*)	P to R3
15. B × Kt	K × B (*d*)
16. Q to R5	Q to Q5
17. R to B sq. (ch)	K to K2
18. Kt to Q2	B to K3
19. Kt to B3	Q to K6 (ch)
20. K to Q sq.	Kt to Q2 (*e*)
21. R to QB sq.	Kt to B3
22. Q to Kt6	R to KB sq.
23. R to K sq. (*f*)	Q to B5
24. P to Q4	KB × P ? (*g*)
25. Kt × B	B to Kt5 (ch)
26. R to K2 (*h*)	R to Q sq.
27. Q × KtP (ch)	K to K sq.
28. Q to Kt6 (ch)	K to B sq.
29. P to B3	P to Kt6 !
30. P × P	P × P

Position after Black's 30th move.

Black.



White.

31.	K to K sq. (*i*)	Q × R (ch)
32.	K to B2	Q to B5 (ch)
33.	Kt to B3	B to R4 (*j*)
34.	Q to B5	Q × Q
35.	P × Q	R to Q4
36.	R to K6	R × P
37.	R × P	K to Kt2
38.	R to Kt6	B to B2
39.	K to K sq.	R to QR4
40.	Kt to Q4	R to R7 ? (*k*)
41.	Kt to B5 (ch)	K to Kt3
42.	Kt to K7 (ch)	K to Kt2
43.	Kt to B5 (ch)	K to Kt3
44.	Kt to K7 (ch)	K to Kt2 (*l*)

Drawn.

NOTES.

(*a*) An innovation, giving quite a novel turn to the opening. The authorities all, we believe, advise 5. QKt to B3.

(*b*) Involving the sacrifice of the two minor pieces for the Rook and two Pawns, and giving rise to a very animated game.

(*c*) White could have sacrificed this Knight, too, and subsequently recovered the piece, but Black would have remained with a fine game, *e.g.*, 14. R to KB sq., P × Kt. 15. B × Kt, P × B. 16. Q to R5 (ch), K to Kt2. 17. Q × B, P × P. 18. R to QKt sq., P to R6 ! &c. But, in any event, would not 14. Kt to Q sq. have been better than the text play ?

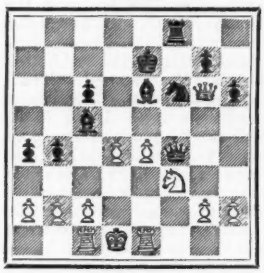
(*d*) Forced, on account of the threatened check at R5.

(*e*) 20. P to Kt6 looks very promising just here.

(*f*) If 23. Q × KtP (ch), R to B2. 24. Q to Kt3, when 24. Kt × P, followed by K to Q sq., appears to give Black a most powerful attack.

(*g*) We believe Black had a forced win here by 24. Kt to Kt5, instead. Suppose 24. Kt to Kt5. 25. P × B (or A), R to Q sq. (ch). 26. Kt to Q2, Q × Kt mate. If 26. K to K2, B to B5 mate.—(A) 25. Q × KtP (ch), R to B2. 26. Q to Kt6 (best), Kt to B7 (ch). 27. K to K2, B to B5 (ch). 28. K × Kt, B × QP (ch). 29. R in, B × R mate. If 26. Q to R8, then B to B5 wins off-hand.

Black.



White.

(*h*) Best. 26. Kt to B3 would lose by 26. R to Q sq. (ch). 27. K to K2, R to Q7 (ch). 28. K to B sq., B × Kt. 29. Q × P (ch), K to K3! and wins.

(*i*) Black threatened Kt × P, to which there would be no saving response.

(*j*) Mr. Judd correctly observes that 33. B × Kt was best here.

(*k*) 40. R to R8 (ch), instead, was the correct continuation, as Mr. Judd shows in the following variations : 40. R to R8 (ch). 41. K moves, R to QKt8. 42. Kt to B5 (ch), K to Kt3. 43. Kt to K7 (ch), K to Kt4. 44. P to R4 (ch), K × P. 45. R × Kt, R × P (ch) with a good chance to win.

(*l*) If the K go to Kt4, the P checks.—*Times Democrat.*

SOLUTION.

Problem No. 126. By I. G., p. 208.

1. Q to B3, P × Q	2. P to Q4 mate
Q × Q	2. Kt to Kt6 mate
K × R	2. Q × Q mate
R × R	2. Kt to B7 mate
Kt to K3	2. R × R mate, &c.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W. Horvat.—In Problem 124, if 1. B to B3, Q to QKt2, then 2. Q to Kt8 (ch), Q to Kt6 (ch). 3. Q × Q mate.

S. B. C.—In Problem 126, if 1. P × Q, B moves, and there is no mate.

Correct solutions received : Problem 126, Donna, H. A. N., W., Uncle John, G. W. Thompson, M. T. Hooton, W. H., E. Ridgway, Arthur Rutherford, A. W. Overton. Problem, No. 127 : H. A. N., W. Problem, No. 128 : A. W. Cunard, W. H. B. Hope, Geo. W. Thompson, H. A. N., W.

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